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Cover: All that remains of the once-proud ship CARIBIA is its broken bow at the entrance to Apra Harbor, Guam --one of the casualties of tropical storm Mary. For further details on this storm, see page 213. Photo courtesy of Pacific Daily News, by P.J. Ryan.

Back Cover: The bow of the SPARTAN LADY sinks into the North Atlantic in relatively calm seas, after getting a helping hand from the USCGC TAMAROA's guns, on April 7, 1975. For details on the storm that the casualty occurred in, see "Monster of the Month" on page 256. U.S. Coast Guard Photo.

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TROPICAL CYCLONE INTENSITY ANALYSIS AND FORECASTING FROM SATELLITE IMAGERY

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Editor's Note: This article should be of special interest to mariners, as tropical cyclones are one of the most dangerous of the meteorological phenomena on the tropical seas. Knowledge of their location, intensity, and movement is especially important to the marine community. Satellites are a primary tool in accomplishing this task, and this is a method for determining their intensity and predicting their future intensity. This is particularly true in remote areas of the oceans where observations are sparse or nonexistent. This in no way detracts from or reduces the requirement for SHIPS' OBSERVATIONS, as they are the only source of detailed, ground-truth information over the vast ocean areas of the earth.

A more complete version of this article, with detailed rules for applying the Dvorak technique, is published in the May 1975 issue of Monthly Weather Review.

1. INTRODUCTION

The meteorological satellite is uniquely suited to the task of tropical cyclone surveillance. During the past decade, hundreds of storms have been observed throughout their life cycles, providing meteorologists with a wealth of new data.

Early in the meteorological satellite program, the feasibility of using satellite pictures for tropical cyclone analysis was recognized. Methods were devised for estimating the intensity of the tropical cyclone by associating certain cloud features with conventional estimates of its strength (Fett, 1966; Fritz et al., 1966). During recent years, systematic procedures for both the analysis and forecasting of tropical cyclone intensity were developed (Dvorak, 1973). These procedures were designed to improve both the reliability and the consistency of intensity estimates made from satellite imagery. The procedures have been used and tested under operational conditions during the past 3 yr at centers responsible for tropical cyclone surveillance. This paper describes the methods currently in use, with refinements based on these years of field testing.

2. THE TECHNIQUE IN GENERAL

The goal of the technique is to provide good estimates using satellite imagery of the current and future intensity of tropical cyclones. To reach this goal, the technique outlines procedures and rules which combine meteorological analysis of satellite imagery with a model of tropical cyclone development. The model consists of a set of curves depicting tropical cyclone intensity change, with time and cloud-feature descriptions of the cyclone at intervals along the curves. The curves show the intensity changes of a typical cyclone during its life cycle, with departures from this sequence for rapidly and slowly developing cyclones (fig. 1).

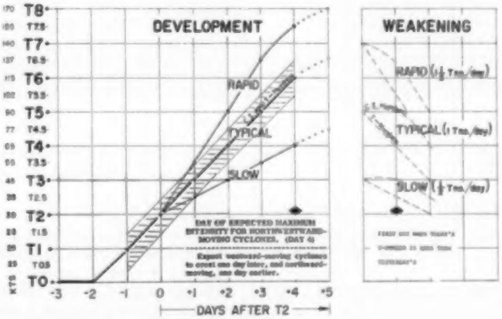

Figure 1.--Intensity-change curves of the model. The shaded area surrounding the typical curve is used to represent "intensity" as a zone one T-number wide. The figure is discussed in section 4.

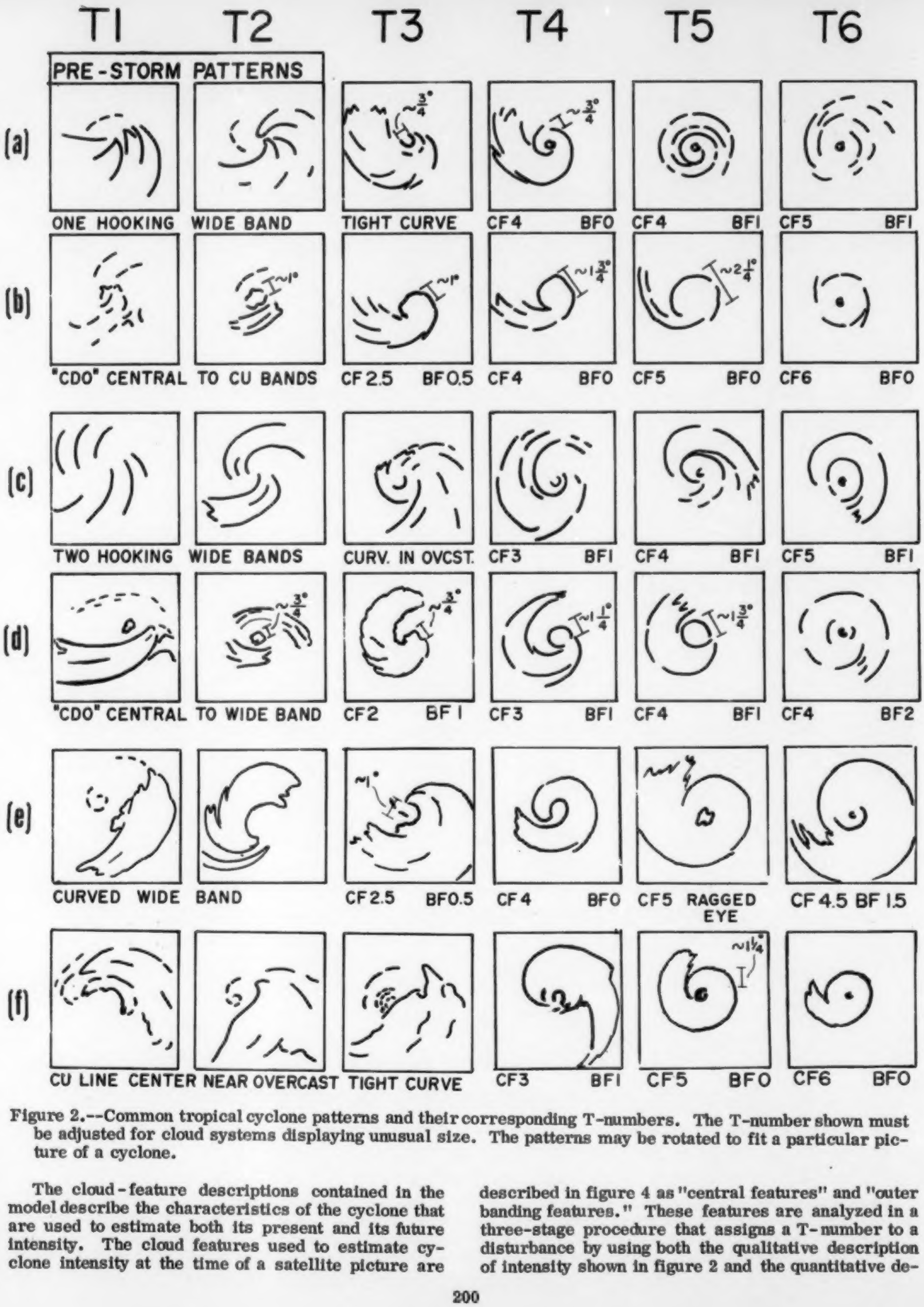

Figure 2.--Common tropical cyclone patterns and their corresponding T-numbers. The T-number shown must be adjusted for cloud systems displaying unusual size. The patterns may be rotated to fit a particular picture of a cyclone.

The cloud-feature descriptions contained in the model describe the characteristics of the cyclone that are used to estimate both its present and its future intensity. The cloud features used to estimate cyclone intensity at the time of a satellite picture are described in figure 4 as "central features" and "outer banding features." These features are analyzed in a three-stage procedure that assigns a T-number to a disturbance by using both the qualitative description of intensity shown in figure 2 and the quantitative de-

Figure 3. -- Examples of the tropical cyclone patterns illustrated in figure 2. The T-numbers shown are the "pattern" T-numbers; these may be adjusted for model considerations.

scription of figure 4. The T(for tropical) - numbers, which range from one to eight, describe tropical (and subtropical) disturbances ranging from those exhibiting minimal, but significant, signs of tropical cyclone intensity (T1) to those characteristic of the maximum possible intensity (T8). The successive T-numbers determined for a cyclone are used to fit the cyclone to one of the three curves of the model or to show departures from a particular curve. The cloud features associated with the cyclone's future intensification are then examined to determine whether the cyclone is likely to remain on its modeled curve during the next 24 hr. The features used in this step provide inferences about the ongoing change of intensity within the cyclone at the time of the satellite picture, and also about environmental changes that will affect the cyclone's future growth.

The procedures and rules of the technique give guidance to, and place constraints on, the intensity analysis and forecast. A cyclone's progress throughout its life cycle is analyzed by continually comparing its cloud features and cloud-feature changes to those expected from model considerations based on the cyclone's past history. Once the initiation of tropical cyclone development is observed, the procedures place the disturbance on the typical curve of the model until

its cloud features indicate a departure from typical.

The typical disturbance is recognized at its initial stage by a specified combination of cloud features about 36 hr before it attains tropical storm intensity. When development is not interrupted by a radical change of environment, the typical cyclone is expected to develop steadily, displaying the modeled amount of daily cloud-feature change. It is also expected to reach maximum intensity after a period of time determined by its direction of motion.

Note that in addition to the typical rate of development, the technique accounts for rapid and slow rates of change, as well as for interruptions in the cyclone's growth rate--the cases in which the cyclone's growth rate departs from the typical curve of the model. The atypical developments are viewed in the procedures as resulting from either a cyclone developing in an unusual environment, or a cyclone undergoing a significant change of environment. Atypical development is detected by means of the absence of, or changes in, those cloud features associated with typical cyclone growth and decay.

3. THE ANALYSIS OF CLOUD FEATURES

The cloud features of the tropical cyclone are divided into two sets; one set is used to estimate its current intensity, and the other, its future intensity. The features are described as they appear in satellite pictures taken during daylight hours from reflected light (visual). Motion picture displays and data from other sensors may also be used as aids to the analysis. At this time, there is too short a period of reliable infrared (IR) data to make detailed classification decisions from them alone. However, some of the more vigorous changes in intensity can be determined from IR data, and, when clear-cut, these changes are used operationally to alter the trends established by the more reliable daytime indications.

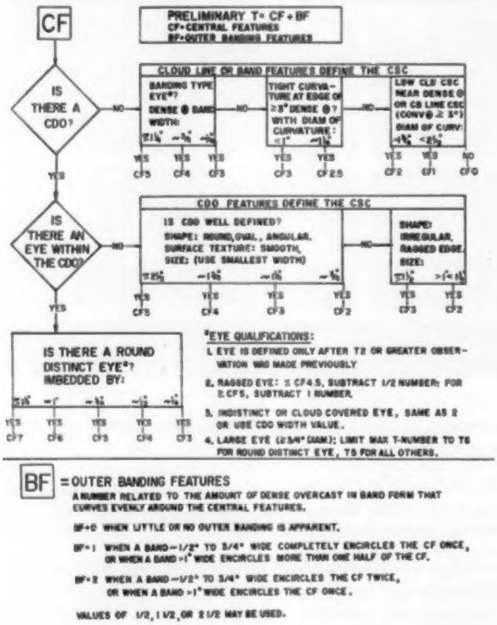

Figure 4.--A diagram for determining the preliminary T-number from cloud feature measurements.

a. Cloud features used to estimate cyclone intensity

Although the tropical cyclones viewed in satellite pictures appear in a great variety of patterns, most can be described as having a comma, or a rotated comma, configuration. The pattern of the comma usually consists of a combination of convective cloud lines that cluster and merge together, and cirrus clouds. The cirrus clouds may add to or detract from the organized appearance of the pattern. The merging end of the comma may appear either to hook inward or to curve broadly around a central core of clouds. These core clouds, which can be thought of as the head of the comma, may appear as curved cloud lines, another smaller comma configuration, or a dense-overcast cloud mass. As the cyclone intensifies, the comma configuration is usually observed to become more circular, with its central core clouds increasing in amount and density.

The cloud features related to cyclone intensity are described in figure 4 as central features (CF) and outer banding features (BF). The central features are those which appear within the broad curve of the comma band and either surround or cover the cloud system center.[1] The outer banding features refer to only that part of the comma cloud band that is overcast and curves evenly around the central features. These two parameters, the CF and BF, and an implied cloud-depth parameter, taken together, comprise the T-number description of the cyclone.

The central features are defined in terms of both the characteristics of the innermost curved cloud line(s) and the characteristics of the central dense overcast (CDO). This is necessary because a cloud system center may be cloud-free and located within the curve of a cloud line on one day and be obscured under a CDO on the next day. The CF portion of the intensity estimate depends on the size, shape, and definition of the central features, as well as on the amount of dense overcast associated with them.

When the innermost cloud lines of the disturbance are visible, indications of cyclone intensity are inferred from cloud features showing the definition of the cloud system center (CSC) and its association with deep-layer convection: that is, the distance between the low-cloud center and an adjacent dense-cloud mass, the pattern and depth of convection in the curved cloud lines defining the center, the radius of the curvature of the innermost deep-layer convective cloud lines or bands, and the characteristics of the eye and the banding encircling it.

[1] The cloud system center (CSC) is located at the center of an eye or at the center indicated by a partial eye wall when one of these features is visible. Otherwise, the CSC is located by fitting circles to the inner curve of the comma band and the curved lines that appear within its broad curve. The CSC is considered to be the center of the area common to all the circles.

When a central dense overcast covers the cyclone's central cloud lines, its characteristics are used in the intensity estimate. The CDO is the dense overcast mass or ball of clouds which is the part of the comma head that appears cradled within the curvature of the comma cloud band. The CDO often appears to be angular or oval in shape during the early stages of the cyclone, and usually becomes larger, rounder, and more smooth-textured as the cyclone intensifies. The characteristics of the CDO are illustrated in rows b and d of figure 2; examples of each pattern are shown in figure 3. At times the CDO appears, through thin cirrus, to be composed of thin, tightly coiled lines. A dense, curved, C-shaped narrow band is often observed to precede the formation of the CDO, which forms after the T3 stage is reached (see figure 2, column T3, rows a, c, and e).

The cyclone eye is defined as either a banding-type eye, or an eye imbedded within a CDO. In both cases, the numerical value of the CF is increased when there is an increase in the amount of dense overcast surrounding the eye, and is decreased for ragged, large, or cirrus-covered eyes. Indications of the eye becoming more distinct, rounder, or more central to the CDO, are used qualitatively as signs of intensification.

The outer banding features (BF) add to the intensity estimate of the cyclone in proportion to the amount and circularity of the dense overcast in band form that curves around the central features. See BF portion of figure 4 and examples in figure 2.

When the cloud features of a cyclone are poorly defined in the imagery, changes in the overall cloud pattern can be used to infer changes in cyclone intensity. The pattern will normally reveal an increase in cyclone intensity by showing an increase in the amount and circularity of the dense central features (CF), or by showing an increase in the amount and circularity of the outer banding (BF).

b. Cloud features used to estimate the cyclone's future intensity

Indications of the ongoing change in intensity within the cyclone at the time of the satellite observation provide clues concerning its future growth or decay. These indications are observed in cloud features that show the cyclone's vertical motions and its inflow/outflow characteristics. A cyclone undergoing typical or rapid development will normally appear as a bright, sharply defined comma configuration, indicating a pattern of strong vertical motions. Its central features will be composed of either deep-layer convective elements or a dense, solid-appearing overcast showing some cirrus. The comma clouds and peripheral clouds equatorward of the cyclone and in its direction of motion will appear strongly convective. The cirrus clouds will appear to be spreading out from the central features in three or more quadrants. This outflow may appear either as clouds with fuzzy edges or as cirrus bands arcing out from the central features. (Caution should be exercised in drawing conclusions from cloud patterns observed early in the morning, since signs of both intensification and intensity often appear weaker than expected at that time of the day.)

A slowly developing or steady-state cyclone will show a lack of one of the characteristics mentioned above or a weakness in several of them. A weakening cyclone will display little evidence of any of them. The possibility of rapid development is to be considered each time all of these characteristics are clearly indicated.

The cloud features related to cyclone intensification are observed to change with the cyclone's changing environment. Environmental changes that result in increasing the cyclone's involvement with land, stratocumulus, unidirectional flow aloft, or apparent "blocking" may affect the cyclone's growth for a short period or permanently. Increasing unidirectional flow aloft is observed as an increase in the cirrus flow across the cloud system. Apparent blocking is indicated when the cloud system is becoming elongated perpendicular to the cyclone's direction of motion. The convective clouds ahead of the cyclone usually appear suppressed when this occurs. When there are signs of increasing involvement of the CF with these influences, a 24-hr interruption or slowing down of development is forecast. And, conversely, when the involvement is expected to decrease, development is forecast to resume.

As a tropical cyclone develops or weakens, it will also usually show corresponding increases or decreases in its CF, BF, or vertical depth parameters over a short period as well as over a 24-hr interval. Short-period changes in these cloud features, however, are often deceptive since they are usually small and can be masked by temporary fluctuations or surges in the cyclone's wind field. The rapidly developing cyclone, however, will exhibit large, short-period changes which override such effects.

c. Initial tropical cyclone development

The earliest signs of tropical cyclone development that have predictive value appear in typical disturbances about 36 hr before they develop to tropical storm intensity. The cloud features that first reveal the development are curved cloud lines associated with deep-layer convective clouds or dense overcast which have persisted for 12 hr or more. The cloud system is normally organized over an area of at least 4° of latitude in diameter, that includes an area of convective overcast or cumulonimbus organization at least 3° in extent. When lines of cumulonimbus are observed, they will appear to merge toward, hook at, or curve around one general area of less than 2-1/2° diameter. When the cloud lines are made up of small-element low clouds which clearly define a center, the center must be less than 1-1/4° from a dense-overcast cloud mass. In both of these types of early development, the cloud system center is clearly defined in one small area, and it is also associated with deep-layer convective cloudiness. When a combination of the two is observed, the distance from the CSC to the overcast may be larger.

Indications of intensification should also be in evidence to insure that continued development will take place over the succeeding 24-hr period. These indications, described in section 3b, are especially important during the earliest stages of development. Of prime importance are the presence of deep-layer, convective clouds near the system center and the absence of strong, unidirectional flow at the cirrus level across the central features. In addition, when clouds appear near the cyclone in its direction of mo-

tion, they should appear convective.

The pattern of the disturbance on the day it first shows significant signs of development may occasionally appear stronger than its surface winds or central pressure indicate. For this reason, the rules prevent an estimate of greater than T1.5 on the first day of development. It appears that rapidly forming initial patterns may at times be reflecting winds that have not had time to reach the surface.

d. Common tropical cyclone patterns

Types of tropical cyclone patterns commonly observed in satellite pictures are illustrated by sketches in figure 2; a photographic example of each pattern is shown in figure 3. In these figures, initial development is shown in the first column on the left (T1), with increasing intensities to the right. The typical cyclone pattern is expected to change by one T-number (one column) during a 24-hr period.

The cloud patterns observed in the T1 and T2 stages of development usually show deep-layer, convective elements in lines clustered together in one or two wide bands. When two bands are observed, they appear to be interlocking (or hooking together) as depicted in row c of figure 2. When one wide band is visible, it usually has organized lines of small-element cumulus within its broad curvature, as shown in rows a, d, and e. Rows a, c, and e show patterns in which the cloud system center is defined by central-band curvature which tightens or coils around the center as intensity increases. Rows b and d show the CDO-type development, with the CDO generally becoming more regular in shape and larger at the higher T-numbers. The figure also illustrates the complementary roles of the central features (CF) and outer banding features (BF) throughout the developmental process. The role of the CF term appears to dominate in the initial stages in rows a and b, while the BF term contributes significantly to the patterns in rows c and d.

The superstorm patterns (T7 and T8, not shown in figure 2) are similar in appearance to the T6 patterns, but exhibit larger CF or BF quantities. A superstorm often has a very distinct eye centered in a round, smooth-textured CDO, or has a CDO which is completely surrounded by a wide, smooth-textured banding feature. Other indications sometimes observed are an eye wall within a wider wall, or an outer banding feature outside of the usual banding feature. Note that the curves in figure 1 indicate that superstorm intensities (greater than T6) occur either in tropical cyclones undergoing continuous development along the rapid curve, or in cyclones moving in a westerly direction during the later stages along the typical development curve.

4. INTENSITY-CHANGE CURVES OF THE MODEL

The intensity-change curves (fig. 1) used in the technique were derived empirically by relating satellite intensity estimates to those obtained from official storm histories, ship reports, and reconnaissance data. The curves depict tropical cyclone development and weakening as occurring along one of three paths which are plots of T-numbers with time. The typical daily change in a tropical cyclone is approximately one T-number a day; rapid and slow changes are one-half T-number per day greater or less than typical. Although the occurrence of the three rates of growth varies somewhat according to season and to ocean, the typical change of T-numbers occurs about 70 percent of the time. The rapid and slow rates of growth occur approximately 10 and 20 percent of the time, respectively, in the North Atlantic; these percentages are reversed in the northwest Pacific Ocean. Figure 1 also includes the day of expected maximum intensity to provide guidance both for the analysis and the long-range intensity forecast.

The modeled guidance depicted in the figure applies only to cyclones developing or weakening in more-or-less homogeneous environments. When the cloud features of the cyclone or its downstream environment indicate a changing environment, the expectation implied by figure 1 must be modified accordingly.

Another feature of the technique is the current intensity (C.I.) number. It is the C.I. number that relates directly to the intensity (in terms of windspeed) of the cyclone for all cases. The C.I. number differs from the T-number to account for factors which are not directly related to cloud features. Two factors that affect the C.I. are the observed delay in the reduction of the (official) maximum windspeed after the cloud features have indicated weakening, and the cresting of the cyclone's maximum winds between satellite observations. Figure 5 shows the empirical relationship between C.I. numbers and maximum windspeeds (MWS), and the T-number's relation to the minimum sea-level pressures (MSLP).

5. THE ANALYSIS PROCEDURE

The intensity analysis consists of three separate stages. The first stage requires a qualitative judgment as to how cloud features related to cyclone intensity have changed between yesterday's picture and today's. To do this, the CF, BF, and vertical depth parameters are examined separately to determine the recent trend of intensity change. This judgment, together with the T-number for the previous day and the modeled curve, provides an estimate of the present and future intensity of the cyclone. The estimate is

C.I. Number	MWS (Knots)
1	25K
1.5	25K
2	30K
2.5	35K
3	45K
3.5	55K
4	65K
4.5	77K
5	90K
5.5	102K
6	115K
6.5	127K
7	140K
7.5	155K
8	170K

T Number	MSLP (Atlantic)	MSLP (NW Pacific)
1		
1.5		
2	1009 mb	1003 mb
2.5	1005 mb	999 mb
3	1000 mb	994 mb
3.5	994 mb	988 mb
4	987 mb	981 mb
4.5	979 mb	973 mb
5	970 mb	964 mb
5.5	960 mb	954 mb
6	948 mb	942 mb
6.5	935 mb	929 mb
7	921 mb	915 mb
7.5	906 mb	900 mb
8	890 mb	884 mb

Figure 5. --The empirical relationship between the current intensity (C.I.) number and the maximum windspeed (MWS), and the relationship between the T-number and the minimum sea-level pressure (MSLP).

modified up or down when an obvious change of environment has occurred during the past 24 hr.

In the second and third stages of analysis, the overall cloud pattern and its component features are examined to see if they agree with the modeled estimate of intensity arrived at during the first stage of the analysis. In the second stage of analysis, the pattern of the cyclone is compared to the generalized patterns in figure 2. A decision is made as to whether the pattern fits best in the column determined by the model estimate or in an adjacent column which may indicate a higher or lower intensity. The T-number that corresponds to the cyclone pattern is adjusted when cloud features displaying unusual size or depth are observed. Unusually large or small cloud systems increase or decrease the T-number by one, respectively.

In the third stage of analysis, a quantified analysis is made of those cloud features studied qualitatively in the first stage of analysis. This is accomplished by use of the flow diagram in figure 4.

The final estimate of cyclone intensity is a C.I. number based either on the T-number implied by the model or on a small (half) T-number adjustment to it. An adjustment is made when the results of the second or third stages of the analysis indicate a significant difference from the model T-number in the absence of conflicting evidence between them. A maximum adjustment of one T-number may occasionally be necessary when the model curve for the cyclone was chosen incorrectly, or when the environment of the storm has changed radically. Once the intensity estimate has been made, the previous satellite pictures of the cyclone are reexamined in the light of the new data. A smoothed curve of all data is then compared to the rapid, typical, and slow curves of the model to determine which will best represent the future history of the cyclone.

The analysis is accomplished most easily and reliably when a comparison is made between pairs of pictures taken by the same satellite system at 24-hr intervals. Such an analysis negates the problems resulting from the differing response characteristics of different satellite sensors, and those resulting from diurnal variations in cloud characteristics or viewing conditions.

6. THE FORECAST PROCEDURE

The intensity forecast is made either by using the cyclone's model curve to obtain tomorrow's intensity, or by adjusting the curve when an interruption due to landfall or the approach of some unfavorable circulation is indicated. Such changes are detected in a recent abnormal change of T-number or in recent changes in the cloud features related to cyclone intensification. The simple modeled forecast implied by the curves in figure 1 must be altered whenever one of three events is in evidence. The first is an obvious reversal in trend indicated by a significant past change of intensity. In this case, either a steady-state condition or a reversal in trend may be forecast, depending on the signs of ongoing change. The second event is that in which all signs of intensification appear opposed to the expected trend. In this case, no change in C.I. number will be forecast during the succeeding 24-hr period. The third event is the case in which the cyclone is entering or leaving an environment that will significantly affect its trend. When this occurs, it is both the cloud features signifying the event and the timing of its occurrence that determine the extent to which the expected trend should be modified.

7. PERFORMANCE

The technique has undergone considerable change and improvement since its inception almost 4 yr ago. The earliest form of the technique was evaluated by Erickson (1972). His results showed good consistency between analysts, with nine out of ten estimated T-numbers of the participants deviating from the instructor's analysis by one number or less. The average difference between the official intensity estimates and those of the instructor and the participants was approximately 12 kn for the instructor and 15 kn for the participants. The test, however, brought to light a consistent bias which resulted in a change in the empirical relationship between T-numbers and windspeeds. More recently, Arnold (1972) published verification statistics comparing operational T-number estimates using the technique with the official Joint Typhoon Warning Center estimates for west Pacific cyclones during the 1972 season. These data show a mean deviation of 8 kn from the official intensity estimates, with a root mean square error of 12 kn and a 24-hr forecast mean deviation of 13 kn from the official postseason estimates.

8. SUMMARY

The technique is a systematic procedure for estimating tropical cyclone intensities using imagery from meteorological satellites. Two sets of cloud characteristics are analyzed, with guidance from a model of tropical cyclone change derived empirically from satellite data. One set of characteristics is used to estimate cyclone intensity. It is made up of three parameters: the central features which define the cloud system center and its relation to dense-overcast clouds; the outer banding features which curve around the central features; and the vertical depth of the clouds comprising these features. Intensity is considered to be related to the sum of the three parameters. The assessment of intensity is made in three stages. The first stage yields a modeled estimate of the cyclone's intensity, while the second and third stages use the cloud pattern and feature measurements to verify or adjust the modeled expectation.

The second set of cloud features is then analyzed to determine if an extrapolation along the cyclone's particular modeled curve is to be used for the 24-hr intensity forecast. These features are related to the intensification processes within the cyclone and to environmental changes which may affect the cyclone during the forecast period.

ACKNOWLEDGEMENTS

The technique described in this paper was developed with the generous assistance of many individuals. In particular, I would like to thank V. J. Oliver, Lee Mace, and A. W. Johnson, whose advice and encouragement at a time when skepticism prevailed made this work possible. Others who provided helpful suggestions were Dr. H. M. Johnson, S. Wright of NESS, and Capt. C. Arnold of JTWC, Guam. I am also in-

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WE OF NOAA ARE MAKING USE OF THIS SMALL AMOUNT OF SPACE TO EXTEND OUR THANKS TO ALL THE SHIPS' OFFICERS WHO ROUTINELY TAKE SHIPBOARD WEATHER OBSERVATIONS. TO US, THESE EXCELLENT OBSERVATIONS ARE PRICELESS. WE CERTAINLY DO APPRECIATE RECEIVING THEM ON A REGULAR BASIS.

WESTERN NORTH PACIFIC TYPHOONS, 1974

Captain Charles R. Holliday, USAF
Fleet Weather Central/Joint Typhoon Warning Center
Guam, Marianas Islands

There was a sharp reversal, during 1974, from the abnormally light tropical cyclone activity observed during 1973. Named tropical cyclones numbered 32, which is 10 percent higher than the latest 15-yr average[1] displayed in table 1. Climatological statistics on typhoons only are given in table 2. Less than half (47 percent) of these tropical storms developed to typhoon strength (15)--well below the average ratio of 65 percent derived from the long-term average shown in table 3. Deviation of normal monthly typhoon distribution was particularly noticeable during July and August, when only three were recorded in contrast to the climatological average of seven.

The number of typhoon days, however, numbered only 62, well below the 15-yr average of 90 days. This reflects the tendency of this season's tropical cyclones not to develop beyond storm strength. (A typhoon day is defined as a day on which a typhoon occurred. Two typhoons on 1 day are counted as 2 typhoon days.)

No supertyphoons (maximum sustained winds $\geq$ 130 kn) were observed during 1974, the first year since documentation began in 1959 that no typhoon reached this category. It is suspected, however, that typhoon Gloria may have approached supertyphoon intensity prior to landfall on the Philippine Archipelago, in early November. This is based on the trend of the central-pressure fall of the final aircraft fixes; however, lack of additional supporting evidence restricts Gloria from being entered in the supertyphoon category.

[1] The climatology of tropical cyclone activity in the western North Pacific during the last 30 yr indicates a significant increase in tropical cyclones since 1960. This is probably due to better observational data, especially satellites, during recent years. Therefore, JTWC considers the last 15-yr period as the most representative of the long-term average.

Table 1.--Frequency of tropical storms (including typhoons) by months and years

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1945	0	0	0	1	1	3	5	7	6	1	3	0	26
1946	0	0	1	0	1	2	3	2	3	1	2	0	15
1947	0	0	1	0	1	1	3	3	5	6	6	1	27
1948	1	0	0	0	2	3	2	3	5	4	3	3	26
1949	1	0	0	0	0	1	5	5	6	1	3	3	25
1950	0	0	0	0	1	1	3	3	3	3	3	1	16
1951	0	0	1	2	1	1	1	2	2	4	1	2	17
1952	0	0	0	0	0	3	3	4	3	5	3	4	25
1953	0	1	0	0	1	2	2	5	3	4	3	1	23
1954	0	0	1	0	1	0	1	5	4	3	3	0	19
1955	1	0	1	1	0	1	6	3	3	4	1	1	22
1956	0	0	1	2	0	1	2	5	5	3	3	1	23
1957	2	0	0	1	1	1	1	3	5	4	3	0	21
1958	1	0	0	0	1	3	5	3	2	5	2	1	23
1959	0	1	1	1	0	0	2	5	5	4	2	2	23
Average (1945-1959)	0.4	0.1	0.5	0.5	0.7	1.5	2.6	4.0	4.3	3.3	2.7	1.3	22.3
1960	0	0	0	1	1	3	3	10	3	4	1	1	27
1961	1	1	1	1	3	3	5	4	6	5	1	1	32
1962	0	1	0	1	2	0	6	7	3	3	3	1	30
1963	0	0	0	1	1	3	4	3	5	5	0	3	25
1964	0	0	0	0	2	3	7	9	7	6	6	1	40
1965	2	2	1	1	3	3	5	6	7	2	1	1	34
1966	0	0	0	1	2	1	5	8	7	3	2	1	30
1967	1	0	2	1	1	1	6	8	7	4	3	1	35
1968	0	0	0	1	1	1	3	8	3	6	4	0	27
1969	1	0	1	1	0	0	3	4	3	3	2	1	19
1970	0	1	0	0	0	2	3	6	4	5	1	0	24
1971	1	0	1	3	4	2	8	4	6	4	2	0	35
1972	1	0	0	0	1	3	5	5	4	5	2	3	30
1973	0	0	0	0	0	0	7	5	2	4	3	0	21
1974	1	0	1	1	1	4	4	5	5	4	4	2	32
Average (1960-1974)	0.5	0.3	0.5	0.9	1.4	1.8	4.9	6.1	4.8	4.3	2.6	1.1	29.2

Table 2.--Frequency of tropical storms reaching typhoon intensity by months and years

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1945	0	0	0	0	0	1	2	5	3	1	1	0	13
1946	0	0	1	0	1	1	2	1	3	1	2	0	13
1947	0	0	0	0	1	1	0	3	4	5	4	1	19
1948	1	0	0	0	2	0	2	2	4	1	2	1	15
1949	1	0	0	0	0	1	3	3	3	1	1	1	14
1950	0	0	0	0	1	1	1	2	1	3	2	1	12
1951	0	0	1	2	1	1	1	2	2	3	1	2	16
1952	0	0	0	0	0	3	1	3	3	4	3	2	19
1953	0	1	0	0	1	1	3	4	2	4	1	1	17
1954	0	0	0	0	1	0	1	4	4	3	3	0	15
1955	1	0	1	1	0	1	6	3	3	2	1	1	19
1956	0	0	1	1	0	0	2	4	5	1	3	1	18
1957	1	0	0	1	1	1	1	2	5	3	3	0	18
1958	1	0	0	0	1	3	4	3	3	3	1	1	20
1959	0	0	0	1	0	0	1	5	3	3	2	2	17
Average (1945-1959)	0.3	0.1	0.3	0.4	0.7	1.0	1.9	3.1	3.2	2.5	2.0	0.9	16.3
1960	0	0	0	1	0	2	2	8	0	4	1	1	19
1961	0	0	1	0	2	1	3	3	5	3	1	1	20
1962	0	0	0	1	2	0	5	7	2	4	3	0	24
1963	0	0	0	1	1	2	3	3	3	4	0	2	19
1964	0	0	0	0	2	2	6	3	5	3	4	1	26
1965	1	0	0	1	2	2	4	3	5	2	1	0	21
1966	0	0	0	1	2	1	3	6	4	2	0	1	20
1967	0	0	1	1	0	1	3	4	4	3	3	0	20
1968	0	0	0	1	1	1	1	4	3	5	4	0	20
1969	1	0	0	1	0	0	2	3	2	3	1	0	13
1970	0	1	0	0	0	1	0	4	2	3	1	0	12
1971	0	0	0	3	1	2	6	3	5	3	1	0	24
1972	1	0	0	0	1	1	4	4	3	4	2	2	22
1973	0	0	0	0	0	0	4	2	2	4	0	0	12
1974	0	0	0	0	1	2	1	2	3	4	2	0	15
Average (1960-1974)	0.2	0.1	0.1	0.7	1.0	1.2	3.1	3.9	3.2	3.4	1.6	0.5	19.1

Table 3.--Ratio of tropical storm development frequency to typhoon intensity (1960-1974)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Average number of tropical storms	0.5	0.3	0.5	0.9	1.4	1.8	4.9	6.1	4.8	4.3	2.6	1.1	29.2
Average number of typhoons	0.2	0.1	0.1	0.7	1.0	1.2	3.1	3.9	3.2	3.4	1.6	0.5	19.1
Ratio	.40	.33	.20	.78	.71	.67	.63	.64	.67	.79	.62	.45	.65

One of the unusual synoptic features during August and September was the penetration of monsoon westerlies to more poleward latitudes than normal. This situation was caused initially by the extremely large circulation of typhoon Mary as she moved to subtropical latitudes. This resulted in an anomalous monsoon trough extending from the coast of South China northeastward to the Ryukyus. Of the four tropical cyclones that developed during this period, three (tropical depression No. 20, tropical storm Rose, and typhoon Shirley) displayed unusual initial courses, compared to climatology, by heading northeastward.

By early October, the monsoon trough became reestablished near its normal position in the Philippine Sea, and triggered development of a series of destructive cyclones which crossed the Philippine Islands. This parade of tropical cyclones, led by Bess in October and climaxed by Gloria in early November, subjected the island of Luzon to the strikes of five typhoons in a period of slightly less than a month. The frequency of these repeated onslaughts to Luzon is unparalleled in climatological records available since World War II.

Based on available casualty reports, typhoons Dinah and Gilda, tropical storm Wendy, and tropical depression No. 20 accounted for the majority of the tropical cyclone-related casualties. Typhoon Gilda proved the

most disastrous of the year. Gilda's circulation triggered flashfloods and landslides in Korea and Japan, in early July, resulting in a heavy toll of lives (128). Damage estimates of $1.2 billion in Japan rank it a-

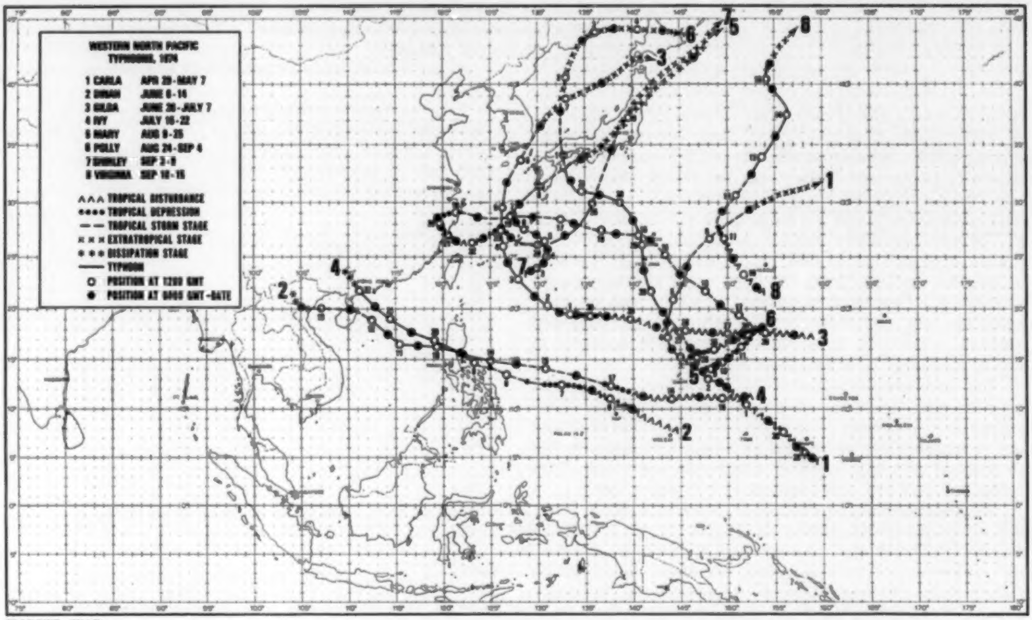

Figure 6.--Tracks of western North Pacific typhoons, April through September 15, 1974.

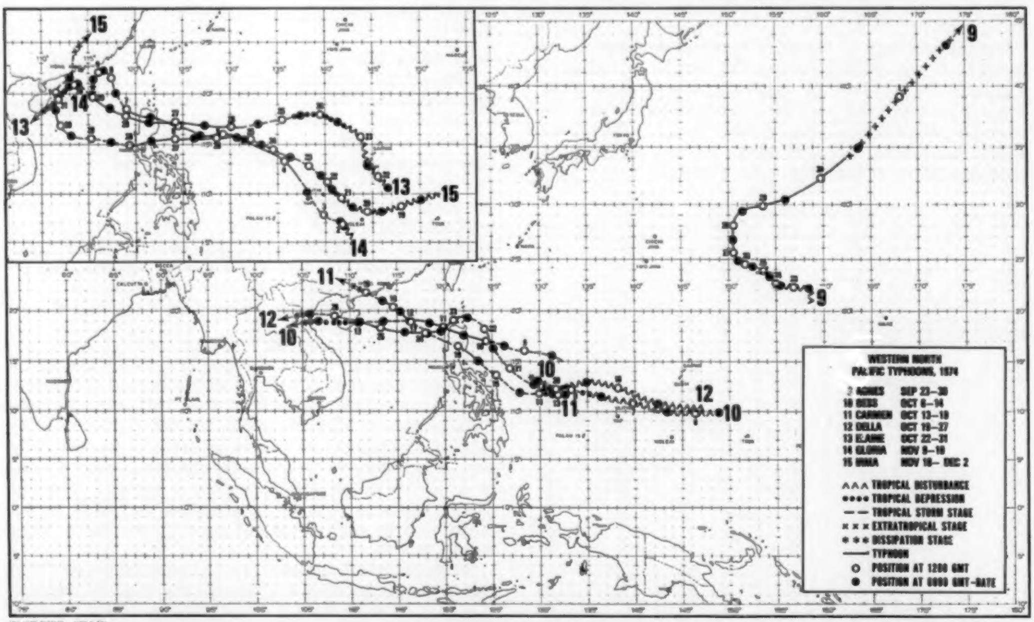

Figure 7.--Tracks of western North Pacific typhoons, September 23 through December 1974.

among the most costly to strike that country in recent years. Torrential rains from the extratropical stages of tropical depression No. 20 produced similar results on the western coast of Korea, in late August,

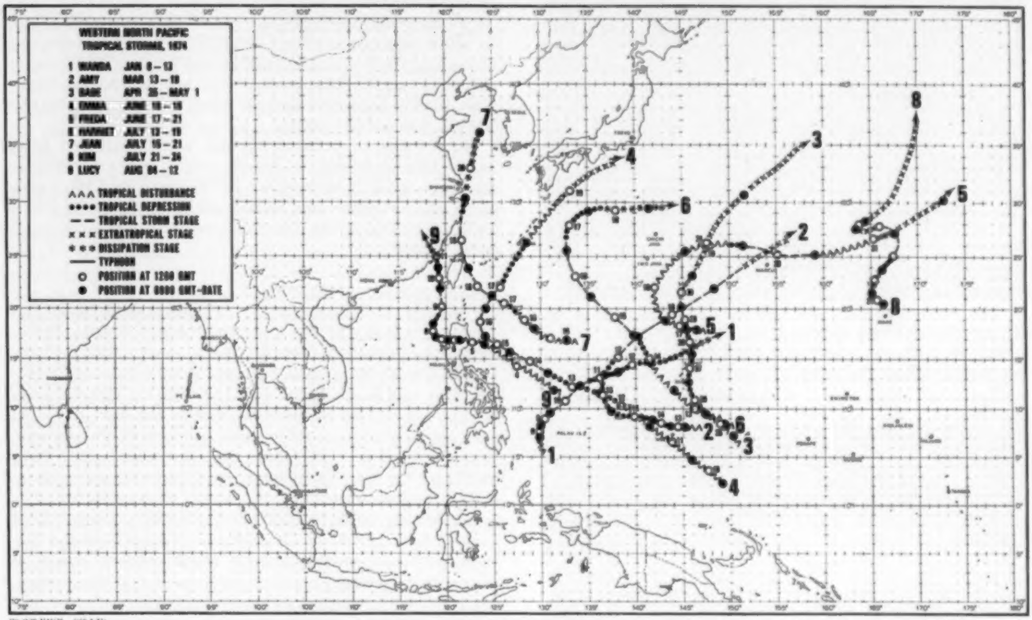

Figure 8.--Tracks of western North Pacific tropical storms, January through August 12, 1974.

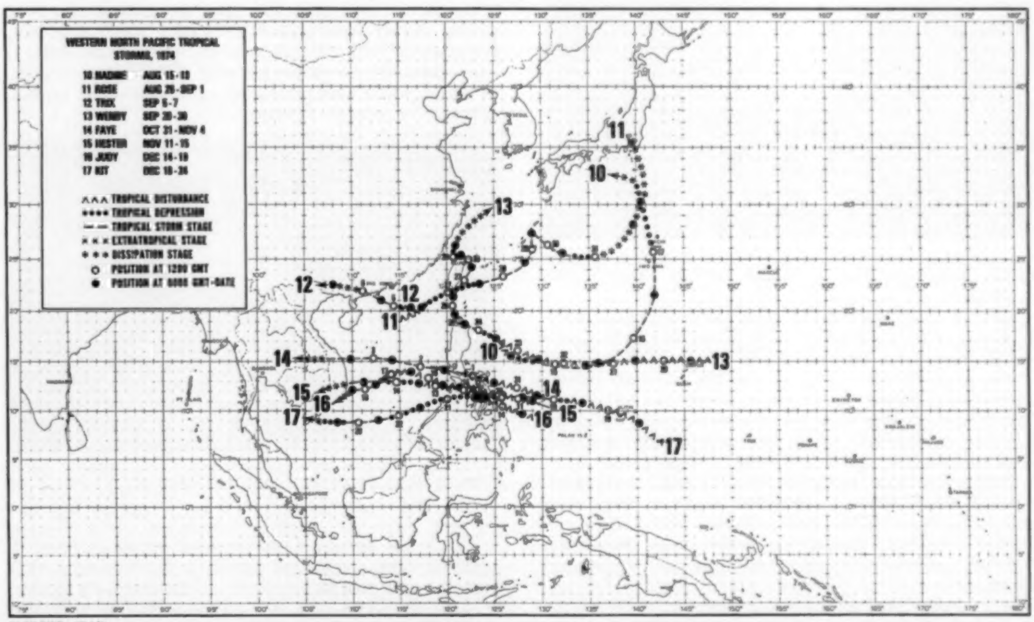

Figure 9.--Tracks of western North Pacific tropical storms, August 15 through December 1974.

accounting for a combined missing and dead total of 77. The worst marine disaster occurred near southern Taiwan, as the 3,500-ton Panamanian freighter SUN SHANG sank in heavy seas produced by tropical storm Wendy (60 kn), with the loss of 31 crewmen.

The northern Philippine Islands experienced a high frequency of typhoons (seven) during the year, with Dinah's crossing of Luzon in June being the most disastrous, as casualties totaled 106 persons. The succession of typhoons during October and November crossing Luzon also inflicted heavy damage, which was estimated at $23 million, to the rice and sugarcane crops, with serious economic impact on the island republic. Reconnaissance of one of these typhoons (Bess), while in the South China Sea, led to the tragic loss of a U.S. Air Force weather reconnaissance aircraft and its crew of six.

The statistics for 1974 storms are contained in table 4. The cyclone tracks shown in figures 6 to 9 are based on poststorm analysis. The dates given include the period when the storm was first identifiable, no matter what stage, until it dissipated or became extratropical. The maximum winds are overwater estimates of sustained windspeeds for a 1-min averaging period.

The individual typhoons during 1974 are described in the following narratives. Specific times and figures are GMT. Tropical storm summaries can be found in the appropriate "Smooth Log" of the Mariners Weather Log.

TYPHOON CARLA

In late April, the monsoon trough became active in the central Carolines, producing a tropical depression that later became tropical storm Babe. Shortly thereafter, another circulation in the trough near Ponape was noted, on April 29. The system tracked northwestward during the next 3 days, as its development was aided by the upper-level outflow of Babe tracking north of the Marianas. By May 2, the circulation was about 225 mi southwest of Saipan and had developed into tropical storm Carla.

Continuing a northwesterly track, Carla's center crossed Tinian, in the south central Marianas, about 0800 on the 3d. The U.S. Coast Guard Loran Station on southern Saipan (located a few miles to the north of the center) recorded a peak gust of 57 kn within an hour after passage of the center. The maximum 24-hr rainfall recorded on Saipan during passage was 2.63 in.

With a midtropospheric, long-wave trough situated between 130° and 135°E, Carla began to turn poleward, late on the 3d. As Carla tracked 100 mi west of the northern Marianas, on the 4th, aircraft reconnaissance indicated its pressure had fallen to 978 mb, and maximum winds around its center neared 65 kn. By 1200 on the 4th, Carla had become the season's first typhoon.

The heavy rains and gusty winds brought to the Marianas by Carla took a heavy toll on fruit crops (bananas, citrus, etc.). Rota, Tinian, and Saipan reported 95-percent damage to crops, while Pagan and Agrihan in the northern Marianas reported 45-percent damage.

Carla continued to deepen, on the 5th, while tracking northward. Reconnaissance aircraft measurements indicated peak intensity was attained early in the day southwest of the Maug Islands, as Carla's central pressure dipped to 963 mb. Maximum sustained surface winds (1 min) were probably close to 80 to 85 kn near the eye at this time.

Increasing tropospheric shear began to weaken Carla after passage north of the 20th parallel, as the cyclone approached the base of the midtropospheric westerlies. Twenty-four hours after reaching peak intensity, Carla was reduced to tropical storm intensity 300 mi east of Iwo Jima.

In advance of a front moving southwestward from Japan, Carla began to accelerate northeastward, on the 6th, and fill in central pressure. By 1200, synoptic and satellite data indicated the remains of Carla had merged with the frontal zone as a weak low near 36°N, 158°E.

TYPHOON DINAH

Dinah's incipient stages can be traced back to a weak circulation in the monsoon trough first noted on synoptic charts, on June 5, in the west central Carolines. The system tracked west-northwestward, passing just north of Ulithi Atoll, early on the 6th, and reaching tropical depression status the next day. As a strong subtropical ridge built westward, the depression crossed the Philippine Sea at a rapid pace of up to 20 kn. On the 8th, it began to slow in forward speed and intensify, about 200 mi east of Samar Island.

Following somewhat of a meandering course, Dinah passed just north of Catanduanes Island, on the 9th, and veered temporarily to a northwesterly track in response to a short-wave trough over the East China Sea. Aircraft reconnaissance indicated that Dinah had developed typhoon-force winds in its northern semicircle during this period. An aircraft measurement, at 0235 on the 10th, shortly before landfall, indicated a central pressure of 974 mb, the lowest observed during the cyclone's lifetime. At landfall (fig. 10), the coastal town of Baler (15 mi south of the center) reported a minimum pressure of 979.8 mb and gusts to 46 kn, while Casiguran, 35 mi north of the center, measured a gust to 47 kn.

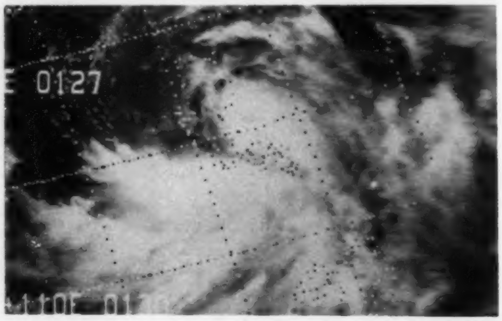

Figure 10.--Typhoon Dinah is about to hit Luzon on the 10th.

Dinah cut across Luzon's mountainous terrain in less than 6 hr, emerging north of the Lingayen Gulf near the town of San Fernando. Torrential rains (24-hr totals up to 19.4 in at Virac and 15.4 in at Baler) set off flash flooding and landslides which claimed a toll of 73 dead and 33 missing. Estimates of damage caused by Dinah were approximately $1 million.

Dinah assumed a westerly course after exiting Luzon and regained typhoon strength by midday on the 11th. Aircraft reconnaissance reported a central pressure of 978 mb, at 0855 on the 11th, within a broad center estimated to be 50 mi in diameter. The Japanese ship MATSUSHIMA MARU passed about 40 mi east of the center a few hours later, at 1200 on the 11th, and reported a minimum pressure of 980.8 mb. Dinah's central pressure varied little thereafter, and its center remained broad until landfall on Hainan Island.

As a high-pressure region over South China advanced into the East China Sea, Dinah shifted course for the Luichow Peninsula on the 12th. Rebuilding pressures, however, blocked Dinah from crossing the South China coast. Following transit of northern Hainan Island, Dinah weakened to tropical storm strength and entered North Vietnam south of Haiphong, quickly dissipating once inland.

While in the South China Sea, Dinah's circulation was extensive; the radius of the area within the 1000-mb isobar was about 360 mi by the 11th. On this day, Pratas Island, 150 mi north of the center, reported sustained winds (10 min) of 30 kn (at 1200), and the Japanese ship NISSHO MARU, 125 mi east of the center, reported estimated winds of 45 kn. By the 12th, an unidentified ship, caught 60 mi north of the center at 0000 on the 12th, reported estimated winds of 45 kn. Later that day, the Chinese meteorological station on the Paracel Islands, 120 mi south of the center, recorded sustained winds (10 min) of 45 kn. Strong, gusty winds were also felt in Hong Kong, on the 12th, as the eye of Dinah passed some 200 to 250 mi to the south and southwest. Wanglan Island in the Colony reported gusts up to 60 kn, and the Royal Observatory, gusts to 64 kn.

TYPHOON GILDA

The third typhoon of the season, Gilda, developed to typhoon strength 450 mi southeast of Okinawa, on July 2. Initial detection of the system was on June 25, about 400 mi north of Eniwetok, as a weak circulation on the trailing edge of a surface trough which extended northeastward to the vicinity of Midway Island. The system tracked westward for 5 days, displaying little marked development based on satellite data coverage. By the 29th, however, signs of increased organization became evident, and, late the following day, Gilda's circulation had generated surface winds of tropical storm intensity.

Gilda began to move poleward, on the 2d, and developed winds of typhoon strength. A stationary, mid-tropospheric trough dominated eastern China. Early that day, at 0600, the Japanese vessel SHINKOYOKU MARU was southbound just ahead of Gilda's path and observed northwesterly winds of 45 kn and a pressure of 988 mb.

The typhoon reached its peak intensity during the next 2 days, as it approached the Ryukyu chain (fig. 11). Reconnaissance aircraft measured a 944-mb central pressure, at 1431 on the 4th, when the eye passed 70 mi southwest of Naha, Okinawa (fig. 12). A peak gust of 85 kn was measured at the Naha Observatory (at 0840) during passage, while on Kume Jima, a gust of 101 kn was registered several hours later (at 1550), when Gilda's eye passed 30 mi to the west.

Heavy rain and gusty winds from Gilda were re-

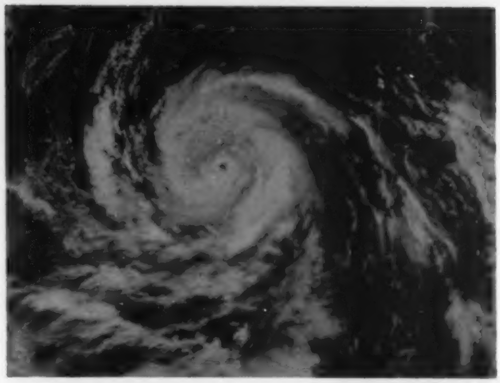

Figure 11.--Typhoon Gilda, near peak intensity, 100 mi southwest of Naha, Okinawa, at 0227 on July 3, 1974. Defense Meteorological Satellite Programs (DMSP) Imagery.

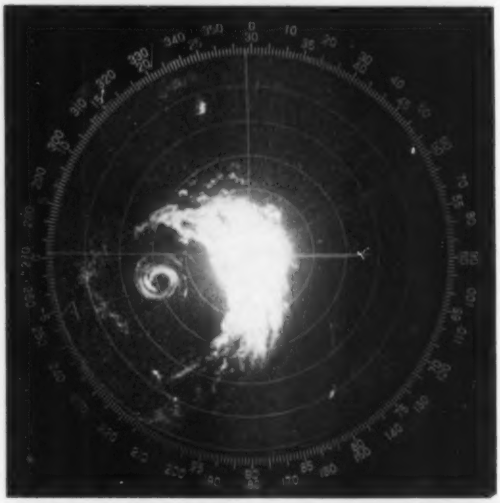

Figure 12.--Typhoon Gilda as observed from the Naha, Okinawa, radar, at 2027 local time on July 4, 1974, as the typhoon passed through the Ryukyu Islands. Billie's eye is located 75 mi west-southwest from the station. Courtesy, Japan Meteorological Agency.

sponsible for almost a complete failure in Okinawa's electric power. Heavy rains (up to 10.8 in at Naha) also accounted for numerous landslides and local flooding. One person was reported killed, and several fishing vessels sank. Crops, including sugarcane, bananas, and vegetables, suffered extensive damage.

As the typhoon entered the East China Sea, it tracked northward around the western periphery of the mid-tropospheric subtropical ridge. Diminishing in intensity while approaching Cheju Do Island, early on the 6th, Gilda responded to increasing upper-level southwesterly flow over Manchuria and began to accelerate. By the 7th, Gilda's circulation was in the Sea of Japan

as an extratropical system heading toward southern Hokkaido.

Gilda brought torrential rains to Korea during passage near the southeast coast, with total rainfall amounts exceeding 10 in near coastal areas. The highest amount of 10.8 in was measured at Kwangyang. The heavy rains caused flash flooding and landslides which completely or partially destroyed over 700 dwellings and left over 6,000 homeless. Total damage loss was estimated at $2.8 million, with casualties of 21 dead and 11 missing.

Meanwhile, Gilda's circulation activated a stationary front over western and central Japan which produced torrential rains over a widespread area. The coastal town of Owase, on the Kii Peninsula, reported an extreme 24-hr total of 16.5 in.

Newspaper reports indicated Gilda caused an estimated $1.2 billion in property damage, including tens of thousands of flooded homes, damaged roads, and washed-out railway lines and bridges. The toll in Japan from landslides and flash flooding accounted for 106 dead and 15 missing.

TYPHOON IVY

The 0000 synoptic chart for July 17 depicted multiple tropical cyclones over the Philippine Sea. Harriet was weakening to depression status east of Okinawa as Jean was developing east of the Luzon Strait. There also was evidence of the strengthening of a depression in the monsoon trough, 250 mi west-southwest of Guam. The last system, destined to become Ivy, intensified to tropical storm force late that day. Within 2 days, Ivy struck Luzon as a well-developed typhoon.

Ivy's track across the Philippine Sea was affected by a strong subtropical ridge that resulted in movement speeds of 15 to 18 kn. Once tropical storm Jean crossed into the East China Sea, the subtropical ridge built westward and prevented typhoon Ivy from taking the climatological northwesterly track. Instead, the typhoon was forced to maintain a westerly course near the 15th parallel. It began to deepen rapidly on the 18th. Its central pressure dropped 32 mb in 20 hr, reaching a minimum pressure of 945 mb, at 1037 on the 19th (fig. 13), about 15 hr prior to landfall. Filling slightly, Ivy struck the Luzon coast south of Baler with sustained winds of 90 kn, early on the 20th. A peak gust of 97 kn from the east and a minimum pressure of 973 mb were reported at the Baler meteorological station during eye passage.

The severity of the turbulence associated with Ivy prior to landfall on Luzon was attested to by an aircraft reconnaissance crew, late on the 19th. During penetration of the wall cloud, turbulence was sufficient to flame out one of the WC-130's four engines. Fortunately, engine restart was accomplished by the crew while orbiting in the eye.

After crossing central Luzon, Ivy emerged into the South China Sea from the Lingayen Gulf and quickly regained the strength lost during transit over the mountainous terrain. In response to a midtropospheric trough positioned just east of the Tibetan Plateau, Ivy began to take a more northerly course, gradually slowed in forward speed, and intensified as it approached South China (fig. 14). Estimates based on satellite data indicated that, prior to landfall just east of the Luichow Peninsula, on the 22d, maximum sustained winds near the center were probably in the 85- to 95-kn range.

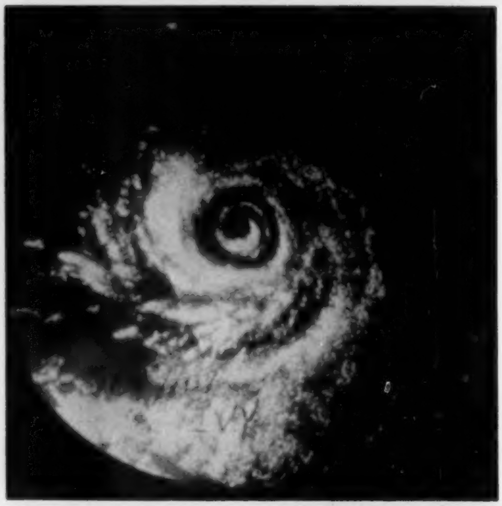

Figure 13.--Typhoon Ivy as observed from Paranal Air Station Radar, Philippines, at 1515 on July 19, 1974. The typhoon is off-centered on radarscope, with the eye 107 mi north of the station. U.S. Air Force Photo.

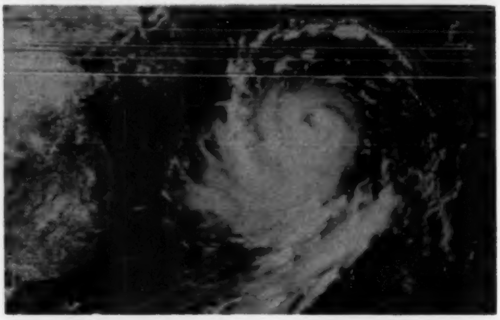

Figure 14.--Typhoon Ivy in the South China Sea, 250 mi south of Hong Kong, at 0339 on July 21, 1974. DMSP Imagery.

The circulation of Ivy caused gale-force gusts at Hong Kong, as she passed 150 mi south of the Colony. Peak gusts of 63 kn and 55 kn were recorded on the exposed islands of Cheang Chau and Wanglan Island, respectively. Maximum 24-hr rainfall was relatively light at the Royal Observatory, with only 1.4 in recorded on the 22d. Ivy's circulation quickly lost identity after moving inland, midway through the 22d, and the system disappeared from the surface analysis 24 hr later.

In the Philippines, the typhoon's casualty aftermath mounted to 66 persons, with 46 of these listed as missing. Hardest hit by Ivy was Baler, a town of 15,000, in which newspaper reports indicated 50 percent of the houses were leveled. Also in the Polillo Island group in Lamon Bay, 42 fishermen were reported lost following Ivy's passage. Estimates of dollar damage to structures, crops, and livestock in Luzon were placed at $2 million.

Table 4. --1974 western North Pacific tropical cyclones

Name	Intensity	Date	Maximum surface wind (kn)+	Minimum observed sea level pressure (mb)	Deaths*	Missing*
Wanda	TS	January 8-13	55	992	---	---
Amy	TS	March 13-19	45	987	---	---
Babe	TS	Apr. 25-May 1	60	983	---	---
Carla	TY	Apr. 29-May 7	80	963	---	---
Dinah	TY	June 6-14	70	974	73	33
Emma	TS	June 10-18	60	988	---	---
Freda	TS	June 17-21	45	989	---	---
Gilda	TY	June 26-July 7	90	944	128	26
Harriet	TS	July 13-19	45	996	---	---
Ivy	TY	July 15-22	95	945	20	46
Jean	TS	July 15-21	45	995	---	---
Kim	TS	July 21-24	50	989	---	---
Lucy	TS	August 4-12	54	995	---	---
Mary	TY	August 9-26	70	964	13	---
Nadine	TS	August 15-18	50	982	---	---
Olive	TS	(Central Pacific Hurricane Center)				
Polly	TY	Aug. 24-Sept. 2	95	948	9	8
----	TD No. 20	August 26-29	30	994	9	68
Rose	TS	Aug. 26-Sept. 1	50	985	---	---
Shirley	TY	September 3-9	70	972	---	---
Trix	TS	September 5-7	40	---	---	---
Virginia	TY	September 10-15	75	969	---	---
Wendy	TS	September 20-30	60	984	47	7
Agnes	TY	September 23-30	105	961	---	---
Bess	TY	October 6-14	65	980	33	3
Carmen	TY	October 13-19	75	974	25	1
Della	TY	October 19-27	90	958	36	21
Elaine	TY	October 22-31	95	943	34	20
Faye	TS	Oct. 31-Nov. 4	55	987	---	2
Gloria	TY	November 2-10	120	931	10	---
Hester	TS	November 11-15	35	1000	11	---
Irma	TY	Nov. 18-Dec. 2	115	939	11	---
Judy	TS	December 14-19	40	998	---	---
Kit	TS	December 18-24	40	995	17	---
					468	235

+ Estimate over water (period--1 min)
* Statistics recorded as available
TD - Tropical Depression; TS - Tropical Storm; TY - Typhoon

LONG-LIVED TYPHOON MARY

From its early stages east of the Marianas to final dissipation over Japan, Mary's behavior was atypical of a tropical cyclone. Mary's circulation during the early stages was marked by maximum wind bands removed from the center by several hundred miles. In addition, the storm's circulation reached enormous proportions, dominating the weather events over the entire Philippine Sea for several days. The longest-lived tropical cyclone of the season, Mary persisted for 17 days, with 2-1/2 of these days spent inland from the East China coast. Mary culminated her unusual behavior by defying climatology, leaving the East China coast on an easterly heading, and regenerating to typhoon strength.

First identified as a weak circulation on synoptic surface charts on July 9, Mary developed to depression status, by the 11th, in the monsoon trough some 250 mi east of Saipan. It is significant that, during this period, surface pressure drops of 5 mb below normal were occurring along the trough across the Philippine Sea. As a result, the monsoon westerlies began to intensify and produced a narrow belt of winds averaging 25 to 30 kn feeding into the depression. By the 11th, satellite data revealed a band of cloudiness extending from the Philippine Archipelago to the eastern Carolines in response to the strengthening monsoon flow.

Initially moving northeastward, Mary's circulation began to generate winds of tropical storm force, late on the 11th. Thereafter, the storm shifted to a northwesterly course, abruptly accelerating in forward speed to 14 kn on the 13th. Mary's circulation was characterized during this period by the existence of maximum wind bands far removed from the low-pressure center. Reconnaissance aircraft reports, on the 11th and 12th, indicated that the center was becoming increasingly separated from the associated convective

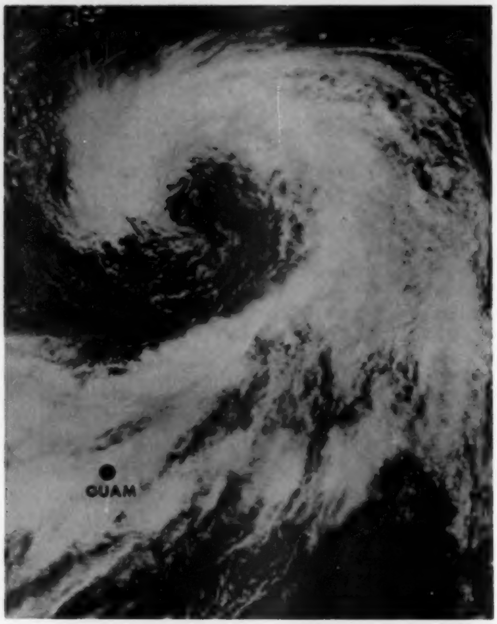

Figure 15.--Tropical storm Mary, appearing as if an extratropical low system, is centered 220mi southeast of Iwo Jima, on August 14, 1974, at 0118. DMSP Imagery.

cloudiness. By the 13th, the center was 200 mi from the nearest convective band. The dimensions of the anomalous structure were readily apparent in satellite views on the 14th. By this time, a band of convective cloudiness spiraling around the center in a broad arc was evident--a pattern quite similar to an extratropical low (fig. 15).

As Mary's center took a poleward component on the 12th and 13th, the associated convective band leading into the circulation, and trailing some 500 mi south and southwest of the center, drifted over Guam. Winds gusting to gale force occurred over a period of 3 days, starting early on the 11th. Peak gusts from the southwest reached 57 kn, at 0950 on the 12th and 2013 on the 13th, at Andersen AFB. Rainfall amounts of 7.25 in in 24 hr were recorded at Andersen AFB, between the 11th and 12th, as the island lay beneath Mary's outer convective band. This extreme 24-hr rainfall exceeds all records for August on Guam.

The persistent, strong, southwesterly winds were responsible for significant damage to marine interests on Guam. The CARIBIA, a 40,000-ton passenger liner (fig. 16) being towed to Taiwan for salvage, broke loose from her tug at the entrance to Apra Harbor, on the 12th, ran aground on the breakwater, and later sank. An estimated $3.3-million loss was associated with the sinking of this vessel. The heavy seas also took their toll on small craft, which are normally protected on the leeward side of the island in the trades, as many broke their moorings and went aground. One yacht valued at $250,000 was included among the lost vessels. Two lives were lost due to drowning, and damage estimates amounted to over $542,000 in the Territory.

On Rota, Tinian, and Saipan, crops were especially

Figure 16.--The Panamanian liner CARIBIA impaled on the tip of Glass Breakwater, Apra Harbor, as waves due to tropical storm Mary's wind crash over the bow. U.S. Navy Photo.

hard hit by the strong winds and torrential rains. On Tinian, the vessel MARIANAS broke from its moorings and went aground. In the northern Marianas, major damage was sustained mostly by copra and banana trees.

As Mary neared the Volcano Islands, the area of surface pressure of 1000 mb or less was exceedingly large--stretching at its greatest diameter some 1,200 mi in a north-northeast/south-southwest orientation, and 850 mi in and east-west direction (fig. 17). The

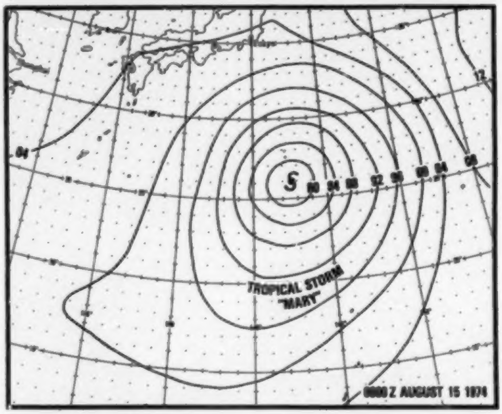

Figure 17.--Synoptic chart of August 15, 1974, at 0000, showing the immense circulation of the storm.

unusually low pressures in the trough trailing Mary southwestward into the Philippine Sea resulted in the development of a tropical depression some 350 mi north-northwest of Yap. Moving eastward in Mary's circulation, the depression apparently interacted with the tropical storm by midday of the 14th, when it approached within 700 mi of Mary's center. Mary's forward motion began to slow, and the storm abruptly shifted to a westerly course, early on the 15th (fig. 18). Meanwhile, the strong tropical depression ac-

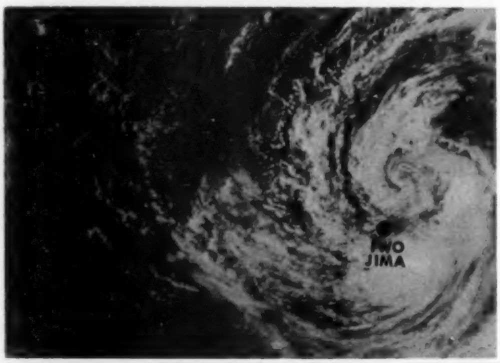

Figure 18.--Tropical storm Mary is centered 150 mi north of Iwo Jima, at 0241 on August 15, 1974. DMSP Imagery.

celerated in forward speed around Mary's southeastern side and dissipated due to the excessive vertical shear.

Late on the 14th, the center of Mary's broad eye passed 35 mi south of Chichi Jima. The island's meteorological station reported a minimum pressure of 977.1 mb, at 2240 on the 14th -- only slightly higher than an aircraft reconnaissance central pressure observation of 972 mb a few hours later, at 0217 of the 15th.

On the 15th, a second depression was spawned 300 mi east of Luzon, in the low-pressure envelope trailing Mary. Accelerating eastward in Mary's circulation, Nadine developed to tropical storm force late that day. Once Nadine was within 700 mi of Mary's center, late on the 15th, a second interaction occurred, resulting in Mary's continued westward movement.

A long-wave, midtropospheric trough west of Lake Baykal began to deepen, on the 16th, resulting in a rapid building of a ridge downstream over Manchuria, with a high-pressure cell centered near Port Arthur. This abnormally strong HIGH blocked any further poleward movement and caused Mary to maintain an anomalous westerly course until landfall on the East China coast on the 19th.

During this westward movement, satellite data indicated that Mary developed a more tropical appearance, as a canopy of cloudiness covered the cyclone's center. Mary intensified slightly, and, for a short period on the 18th, winds reached typhoon force as the storm cut through the Ryukyu chain. Naze city on Amami-O-Shima reported the lowest pressure--979.6 mb at 0240--as Mary's center tracked 20 mi to the north. The highest winds in the Ryukyus were measured at Yakushima Island, which recorded a peak gust of 90 kn at 0040. As the typhoon's precipitation swept over southern Kyushu, heavy rainfall varying between 8 and 11 in was reported in the mountainous areas. Miyakonjo on Kyushu measured the largest 24-hr total of 6.4 in, during the 18th.

Moving inland on the China coast about 100 mi south of Shanghai, late on the 19th, Mary was blocked from moving into the mountainous interior by a high cell over central China. As a result, Mary stalled just inland as a deep depression for several days. Meanwhile, the mistropospheric ridge over Manchuria began to break down rapidly, as a developing midtropospheric trough east of Lake Baykal began to deepen equatorward.

By the 22d, the increasing westerly flow west of and over the Gulf of Chihli forced the depression back out over the open waters of the East China Sea.

Regenerating to minimum storm strength on the 23d, Mary passed over Okinawa as a "back door" storm, early on the 24th, increasing in forward speed to 12 kn during the crossing. The meteorological station at Kadena Air Base registered a minimum pressure of 981 mb, at 0105, and a peak gust from the northwest of 41 kn. Center passage was estimated 18 mi to the north of Kadena. At the Naha Observatory, a peak gust of 58 kn was recorded at 0330 of the 24th. Later in the day, Mary passed just north of Minami Daito Jima, as the storm again achieved typhoon intensity. The Japanese weather station on the island experienced a peak gust of 90 kn, on the 24th at 1707, and a minimum pressure of 969.3 mb, 3 min earlier.

The development of a LOW within a midtropospheric trough over Korea began to draw Mary on a northerly

course, late on the 24th. Due to the tightening gradient over Japan created by this deepening trough and a subtropical ridge positioned east of Honshu, Mary accelerated north-northeastward, reaching a forward speed of 25 kn prior to striking Honshu, near Hamamatsu, on the 26th.

Mary briefly maintained typhoon status on the 25th, but the cyclone's winds dropped to storm strength prior to landfall on Honshu. Further evidence of Mary's rejuvenation came from aircraft reconnaissance, late on the 24th, which observed a 15-mb pressure drop in 24 hr, to 964 mb at 2141. Several hours later, the British vessel W. C. VAN HORNE was caught near the eye of the typhoon, while 30 mi east of the center. Winds of 70 kn from the south and a pressure of 981.8 mb were reported from this vessel, at 0600 of the 25th. When she crossed the Japanese coastline near Hamamatsu, at 0030 on the 26th, the meteorological station indicated Mary's central pressure had risen to 986.2 mb. Thirty minutes prior to center passage, a peak gust of 63 kn was recorded at the station. Elsewhere along the coast, Omaezaki reported a southerly gust of 69 kn, at 0050.

Merging with a frontal system over Japan, Mary became extratropical, moving inland over Honshu, early on the 26th. Heavy rains spread over the north central region of the island, with the greatest 24-hr amount of 8.98 in occurring at Nikko. On the southern coast, Shizuoka City recorded a 24-hr total of 6 in.

Only one casualty occurred in the Japanese islands as a result of Mary; however, strong winds associated with Mary over the Sea of Japan were responsible for capsizing a fishing trawler off Cape Amasaki. Of a crew of 11, only 1 was rescued.

TYPHOON POLLY

While Mary was accelerating toward central Honshu, satellite data revealed that another disturbance, induced from an upper-level LOW, was showing signs of development 400 mi east of the northern Marianas. Midday on the 26th, the circulation system intensified into tropical storm Polly, about 40 mi northeast of Saipan. Development was rapid thereafter, as the storm's central pressure dropped 25 mb in a period of a day, after an aircraft reconnaissance reading of 989 mb at 2056 on the 26th.

Polly's movement in the central Marianas was erratic, as the storm was impeded by a high-pressure cell located to the southwest near Yap. By the 27th, however, the flow about a strong HIGH east of Japan dominated, and Polly departed the "col" region between the two anticyclones, increasing in forward speed to 12 kn.

Veering northward late on the 28th, the typhoon took aim on the Volcano Islands. Polly's central pressure continued to fall, terminating at a minimum value of 948 mb, 170 mi south of Iwo Jima (fig. 19). Twelve hours later, the typhoon passed abeam of Iwo Jima and, later on the 29th, passed about 70 mi west of Chichi Jima. Iwo Jima reported peak gusts of 108 kn from the south, at 0705 on the 29th, after the eastern edge of Polly's 20-mi-diameter eye passed the island. A minimum pressure of 951.5 mb was registered in the eye. Later, at 1240, Chichi Jima recorded a peak gust of 88 kn from the east-northeast, and a minimum pressure of 989.8 mb at 1900.

During Polly's advancement northward from the Marianas, tropical storm Rose generated east of Taiwan. Late on the 29th, Rose had moved to a position just north of Okinawa, and become quasi-stationary. The proximity of tropical storm Rose 700 mi west of Polly, and a blocking HIGH north and northeast of Polly, resulted in the beginning of a Fujiwara interaction on the 30th (fig. 20). Polly began to turn northwest-

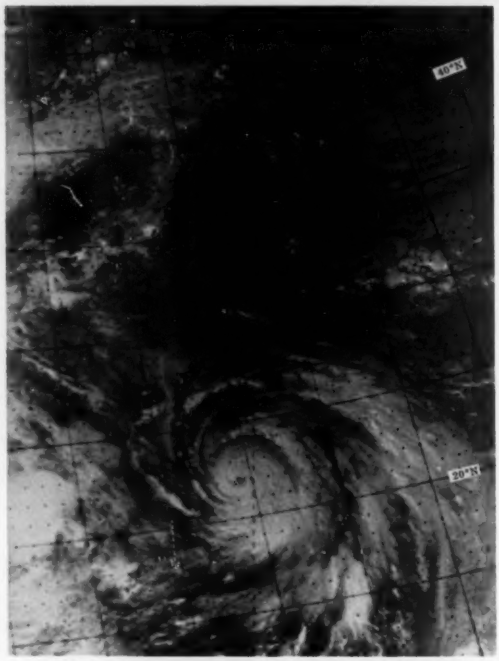

Figure 19.--A moonlight visual shows typhoon Polly, 170 mi south of Iwo Jima, August 28, 1974, at 1444. The lights of Tokyo, 750 mi to the north, and other cities in Japan are visible. DMSP Imagery.

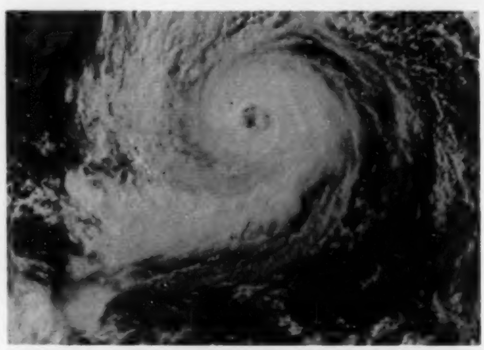

Figure 20.--Typhoon Polly is 250 mi south of Nagoya, Japan. Tropical storm Rose appears further southwest of Polly, centered 230 mi east of Naha, Okinawa, August 30, 1974, at 2300. DMSP Imagery.

to westward during the next day and a half, as Rose sped around the south side of Polly's circulation.

With a long-wave trough over eastern China and Rose weakening significantly on Polly's eastern periphery, the typhoon veered abruptly to a northerly track, late on the 31st. Increasing in forward speed to 15 kn, Polly's center struck the Japanese islands of Shikoku and southwestern Honshu, emerging in the Sea of Japan 6 hr later, on the 1st. Diminishing to tropical storm force in the Sea of Japan, Polly continued a poleward movement, crossing the Russian coast east of Vladivostok as an extratropical LOW on the 2d.

As Polly's eye moved ashore on Shikoku, the Kochi City meteorological station, 20 mi east of the center, measured a minimum pressure of 976.3 mb, at 0920 on the 1st, and a peak gust from the east of 78 kn, at 0930. The Ashizuri station (20 mi west of the center), however, reported the lowest pressure on the coast--966.5 mb at 0740. Murotomisaki (elevation 745 ft, 70 mi northeast of the center) reported the highest gust--95 kn from the east at 0310--several hours before Polly's landfall. Maximum 24-hr rainfall measured on Shikoku Island due to Polly was 11.8 in at the coastal station of Ashizuri.

During the typhoon's passage across Japan, Polly's circulation intensified a stationary front over east central Honshu, bringing excessively heavy rains to the mountainous area west of the Kanto Plain. Ogochi, Tokyo Prefecture, reported a total of 19.7 in during the typhoon's passage, while stations in Saitama and Yamanashi Prefectures received totals of 19.5 and 14.4 in, respectively. These heavy rains set off one of the worst floods in Tokyo since World War II. The swollen Tama River washed over its embankment at Komae, Tokyo Prefecture, flooding many homes and causing 7,600 inhabitants to be evacuated.

Elsewhere, electrical power was cut off in Kochi and Hiroshima, in the path of Polly's center, because of high winds and landslides downing powerlines. On the coast, two 10,000-ton freighters, berthed under construction at Urato Bay near Kochi, were washed out to sea when the water level went up some 9 ft. In the typhoon's wake, Polly left over 10,000 homes destroyed or inundated, and a casualty toll of 45 injured and 9 dead or missing.

TYPHOON SHIRLEY

As Polly transformed to an extratropical cyclone in the Sea of Japan, the monsoon trough re-formed across the Philippine Sea from Taiwan to the Volcano Islands. On September 3, a tropical cyclone was evident in synoptic and satellite data, about 150 mi south of Okinawa. Drifting east- and northeastward, Shirley was about 60 mi south of Minami Daito Jima, on the 4th, when aircraft reconnaissance reports observed winds reaching storm force in the circulation's northern semicircle.

Located at the base of an upper-level trough east of Korea, Shirley drifted slowly northward, passing abeam of Minami Daito Jima, early on the 5th. A minimum barometric reading of 986 mb was recorded at the island's weather station, at 0300. Peak gusts out of the south measured 54 kn at 1300.

As the 500-mb trough over the Sea of Japan moved eastward, on the 5th, rising heights north of Shirley caused the storm to turn westward. By the 6th (fig. 21), aircraft reconnaissance of Shirley indicated winds

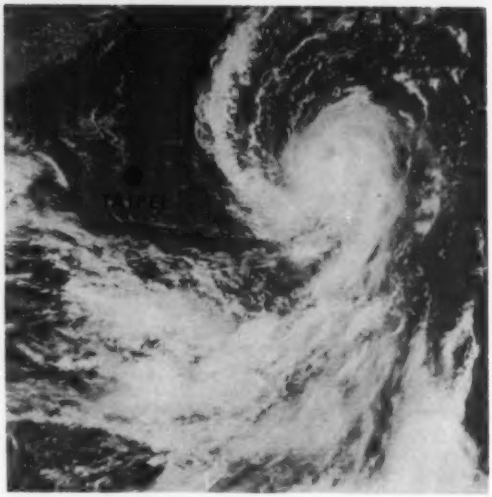

Figure 21.--Shirley reaching typhoon strength, 110 mi northeast of Naha, Okinawa, September 6, 1974, at 0239. DMSP Imagery.

had reached typhoon force shortly before the storm's center passed over the island of Okinoerabu-Shima, in the Ryukyu chain. The barometer dipped to 977.4 mb on the island during center passage (at 1130), and, as winds shifted to the south-southeast, a peak gust of 82 kn was recorded at 1310.

Shirley's circulation was rather small, as gale-force winds were limited to a radius of 75 mi of the center. To the north, Naze on Amami-O-Shima reported peak gusts to 43 kn, at 0150 of the 7th, while to the south, the gust recorder at the Naha Observatory measured 44 kn, at 1530 on the 6th.

An approaching short wave over the Yellow Sea began to draw Shirley on a slow poleward drift on the 7th. As the base of this trough bypassed the typhoon to the north, Shirley accelerated in a northeasterly direction, on the 8th, landing 12 hr later slightly below typhoon force on the coastline of Kyushu. Prior to landfall, the center passed directly over Kusagakishima (elevation 454 ft), which experienced a barometric reading of 982.4 mb, at 0800 on the 8th, and sustained 10-min winds of 70 kn.

The coastal city of Makurazuki, 10 mi south of center crossing, received wind gusts to 90 kn from the south-southeast at 1050, followed by a minimum pressure reading of 985.9 mb at 1120.

Accelerating to a forward speed of 24 kn, Shirley quickly passed Kyushu and Shikoku and transformed into a weak extratropical LOW over the Kii Peninsula on the 9th. Strong, gusty winds occurred along the southern coast of Shikoku, as Shirley's center passed by, late on the 8th. South-southeasterly winds peaking near 42 and 70 kn were recorded at Ashizuri and Murotomisaki (station elevations 142 and 745 ft), respectively.

Torrential rains brought by Shirley totaled 6.2 in in 24 hr at Nobeoka, on the eastern coast of Kyushu, while Tokushima, on the eastern coast of Shikoku,

reported 7.5 in during passage (24 hr). The heavy rains halted the Japanese National Railway services in parts of Kyushu, and completely in Shikoku. Power blackouts were also widespread in Kyushu--a result of gusty winds downing powerlines.

Landslides and flash flooding caused by the rains were responsible for the flooding of over 30,000 homes, and a casualty toll of 13 dead or missing.

TYPHOON VIRGINIA

Developing from a disturbance initiated by an upper-tropospheric LOW, Virginia began to display increasing organization, in satellite data, early on the 11th. She was 200 mi west of Marcus Island. The circulation advanced northward, shifting to a northeasterly course, and developed tropical storm-force winds on the 12th. By the time aircraft reconnaissance was conducted on Virginia, late on the 13th, the winds had increased to typhoon intensity (fig. 22). Flight-level (700-mb) winds of 80 kn were measured in the southern semicircle on penetration, while a central pressure of 980 mb was recorded within an eye 40 mi in diameter.

Figure 22.--Typhoon Virginia near peak intensity after crossing the 35th parallel, 750 mi east of Tokyo, at 2207 on September 13, 1974. DMSP Imagery.

Virginia developed winds of typhoon strength at an unusual poleward latitude of 33°N. This was only the sixth tropical cyclone since 1945 to achieve typhoon intensity north of the 30th parallel.

As a deepening 500-mb LOW approached Manchuria from the Lake Baykal area on the 13th, the accompanying downstream ridging caused the westerlies north of Virginia to weaken and retreat poleward. As a result, the typhoon continued to track northeastward in a favorable vertical shear zone and maintained its intensity. Further aircraft reconnaissance of Virginia, at 0730 on the 14th, revealed the storm was still tropical in character at the 37th parallel. The central pressure had dropped to 969 mb in an eye with a 700-mb temperature of 16°C. Maximum flight-level (700-mb) winds of 90 kn were recorded just outside the eye in the wall cloud region.

By the 14th, a major trough was deepening over Manchuria, causing a strong ridge to develop over the Kamchatka Peninsula. By midday, Virginia was blocked by an anomalous high-pressure cell to the northeast, resulting in a northwestward movement unusual for a tropical cyclone located at such a northerly latitude (37°N). Virginia's tropical lifetime ended shortly thereafter, as satellite data indicated weakening, on the 15th, and development of extratropical characteristics later in the day, 400 mi east of Hokkaido.

During the typhoon's northward track, numerous vessels in the shipping lanes were caught in its circulation and reported gale-force winds. The strongest winds were experienced by the Netherlands ship ZWIJNDRECHT (40 kn) on the 13th, and the PRESIDENT VAN BUREN (45 kn) on the 14th. The Japanese ship AKAISHI, caught near the center at 0000 on the 15th, reported northeasterly winds of 57 kn and a barometer reading of 989.5 mb.

TYPHOON AGNES

Evolving from a disturbance initiated by an upper-tropospheric LOW, Agnes developed to depression intensity about 150 mi southeast of Marcus Island, on September 24. Although weak, the flow about the subtropical ridge to the north of the depression kept the tropical cyclone on a slow westerly, and later a west-northwesterly, track for the next 3 days.

Indications from satellite data, on the 25th, revealed that the circulation was intensifying rapidly. Proof of this development occurred when the center of Agnes passed about 60 mi south of Marcus Island, later that day. The Japanese meteorological station on the island experienced strong easterly gusts to 81 kn, at 1140, following a minimum barometer reading of 998.7 mb at 0600. Aircraft reconnaissance of Agnes the next day (1450 on the 26th) confirmed that the storm had gained typhoon force. Flight-level (700-mb) winds of 70 kn and a central pressure of 984 mb were reported.

As a cell in the subtropical ridge west of Agnes weakened significantly, on the 27th, the typhoon began abruptly to track northward. Upper-level westerlies strengthened east of Japan; Agnes shifted to an east-northeasterly track 36 hr thereafter, and accelerated in forward speed early on the 29th.

Like typhoon Virginia, Agnes continued to deepen after recurvature. Reconnaissance aircraft observed the lowest central pressure of the typhoon's life (961 mb), at 0303 on the 30th. In addition, flight-level (700-

mb) winds of 135 kn were observed 40 mi from the center during exit from the eye. The forward speed of Agnes at this time had increased to 15 kn.

Over the Kuril Islands, a 500-mb LOW was tracking eastward, accompanied by a deep trough. The amplification of the strong southwesterly flow ahead of the trough caused Agnes to turn on a northeasterly course and accelerate to 30 kn by October 1. Satellite data indicated that Agnes had acquired extratropical characteristics after crossing latitude 35°N; however, the circulation remained intense, as evidenced by aircraft 700-mb winds of 110 kn, at 0415 on the 1st. The strong extratropical LOW of Agnes continued to race poleward thereafter, finally merging with the advancing 500-mb LOW, on the 3d, 300 mi south of Attu in the Aleutian chain.

TYPHOON BESS

The circulation that eventually developed into typhoon Bess was first noted on the 0000 synoptic chart, south of Guam, on October 7. The circulation was accompanied by broad monsoonal flow, and, by the 9th, evidence from satellite data and aircraft reconnaissance indicated two centers had developed. The northern system dominated, while the center that had initially been tracked for several days dissipated. Because of a strong subtropical ridge, movement of the entire complex circulation up to this time had been rapid, with a forward speed of 18 kn. Later, a deepening trough in the westerlies over the East China Sea caused the pressures north of the storm to weaken, and Bess slowed to almost half her original speed.

Winds in the cyclone reached typhoon intensity, early on the 10th, as it approached northern Luzon. Approximately 24 hr later, coastal crossing occurred about 50 mi south of Escarpada Point. Inland, Tuguegarao City reported a pressure of 976.9 mb, the minimum reported during the storm's lifetime, when Bess' center passed 30 mi north of the station. Relatively unaffected by a short journey over the mountainous island, Bess emerged into the South China Sea as a minimal typhoon.

Bess' circulation brought high winds which affected much of Luzon and the Strait. Baguio weather station (elevation 4,860 ft) experienced wind gusts to 80 kn, while Aparri on the northern coast recorded a gust to 96 kn. In the Luzon Strait, several ships reported strong winds as the typhoon's center passed, to the south, on the 11th. The Indian ship BAILADIA and the German vessel BAMBERG experienced northeasterly winds of 50 and 57 kn, respectively. Considerable rainfall, with 24-hr totals of 5 to 6 in, occurred over much of northern Luzon, with a 24-hr extreme of 30.8 in measured at Baguio. Landslides and flash flooding accounted for casualties of 26 killed and 3 missing. Total damages, including public and private property, agricultural crops (rice), and livestock, were estimated near $9.2 million.

Once in the South China Sea, Bess turned westward in response to a massive high-pressure area dominating central and southern China. The combination of the typhoon's envelope of low pressure and this high-pressure area generated a strong northeast flow over the waters south of the China coast. Pratas Island, 110 mi northwest of the typhoon's center, reported sustained 10-min winds of 50 kn, on the 12th, while the British MARCO POLO estimated winds of 45 kn, 220 mi northwest of the center. As Bess tracked south of Hong Kong, late on the 12th, peak gusts of 58 and 49 kn were observed at Wanglan Island and the Royal Observatory, respectively.

As the modifying northeast monsoon flow entered the typhoon's circulation, the central pressure began to rise, and winds associated with Bess dropped to tropical storm strength on the 13th. Bess increased in forward speed, crossed Hainan Island late in the day, and weakened to depression intensity. Emerging into the Gulf of Tonkin, the circulation continued to weaken, eventually dissipating on the North Vietnam coast, early on the 14th.

In addition to the damage wrought on the Philippines, Bess claimed a U.S. Air Force reconnaissance aircraft in the South China Sea, south of Hong Kong, on the 12th. Last contact with the mission occurred while the aircraft was collecting peripheral data in the typhoon's northern semicircle. Nothing was ever heard again of the plane or its crew of six (See Mariners Weather Log, Vol. 19, No. 1, page 27.).

TYPHOON CARMEN

As Bess passed south of Hong Kong, the monsoon trough in the Philippine Sea produced another circulation west of Yap. This system moved westward, displaying increasing organization on satellite data. Reports of 45-kn westerly winds and 998.5-mb pressure, received from the Liberian ship ASIAN MORALITY as it passed close to the center, at 0000 on the 15th, confirmed that Carmen had reached tropical storm strength 180 mi east of Samar Island.

Intensifying further, Carmen turned to a northwesterly course and headed for northern Luzon. Some 12 hr prior to the storm's arrival on the Luzon coast near Casiguran, aircraft reconnaissance reported a central pressure of 974 mb, the lowest during its lifetime, and winds of minimal typhoon force.

Casiguran reported gusts to 59 kn and a minimum pressure of 981.2 mb, as the center passed just north of the station. Maximum 24-hr rainfall, recorded as the storm cut across Luzon, was at Baguio (8.98 in). Casualties in the wake of Carmen amounted to 13 dead, and damage losses were estimated near $11.6 million.

Elsewhere, eastern Taiwan suffered crop damage of nearly $1.4 million because of the heavy rains associated with typhoons Bess and Carmen. Newspaper reports indicated 11 persons killed on Taiwan.

As Carmen entered the South China Sea, weakening pressures over east central China influenced the typhoon to slow in forward speed (fig. 23). On the 18th,

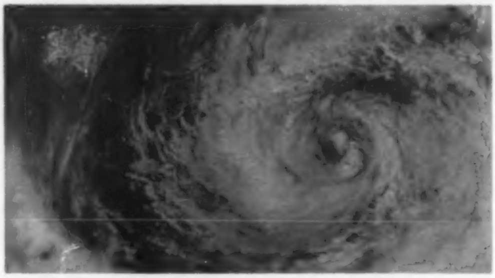

Figure 23.--Typhoon Carmen, 330 mi southeast of Hong Kong, October 17, 1974, at 0329. DMSP Imagery.

satellite intensity estimates indicated Carmen probably reached a peak strength of 75 kn, about 120 mi south of Hong Kong, as the storm edged slowly northwestward.

During the 18th, several ships caught in Carmen's circulation reported strong winds. At 0000, an unidentified vessel experienced northerly winds of 45 kn, 150 mi northwest of the typhoon's center, while the Norwegian ship JARAMA reported easterly winds of 50 kn, 130 mi to the northeast. Later, at 1200 and 0000 on the 19th, the U. S. ship RAPHAEL SEMMES, passing south of the center, reported 60-kn winds.

Following the passage of an upper-level trough over the Yellow Sea, on the 18th, a high-pressure ridge began to penetrate into southern China, causing a northeasterly flow of modified air from the land mass into the typhoon's circulation. Within 24 hr, Carmen's central pressure began to fill rapidly, and her winds dropped to tropical storm force. Turning on a more westerly course, Carmen weakened to depression strength and later dissipated east of the Luichow Peninsula.

The center of Carmen approached within 70 mi of Hong Kong, on the 19th, producing considerable rainfall and gale-force winds in the Colony. Peak gusts of 70 kn were observed both at Wanglan Island and the Royal Observatory. Maximum rainfall during the 3-day period (October 18-20) totaled 18.1 in. Carmen brought much-needed rain to the Colony, which was suffering from a drought; however, heavy downpours flooded many low-lying areas and caused landslides and road collapses (fig. 24). Newspaper reports indicated extensive crop damage due to flooding caused by the rains. Two lighters went aground (fig. 25), and four other vessels broke away from their moorings. One fatality in the Colony was attributed to Carmen.

Figure 24.--Part of the road collapsed during heavy rains from typhoon Carmen at Hong Kong. Photo courtesy of the South China Morning Post.

Figure 25.--Waves batter a half-submerged lighter after it went aground at Little Saiwan, Hong Kong, during typhoon Carmen. Photo courtesy of the South China Morning Post.

TYPHOON DELLA

The third in a succession of tropical cyclones developing during October, Della formed in the monsoon trough south of Guam, while Carmen weakened in the South China Sea, on the 19th. Two days later, the circulation intensified to tropical storm strength approximately 250 mi east of Samar Island.

The subtropical ridge north of Della eroded quickly, on the 21st, as a major short wave in the westerlies approached from China. Della was drawn up into the area of weakness and shifted to a northwesterly, and later a north-northwesterly, track. While winds about the center reached typhoon force, the short-wave trough passed the meridian of Della, late on the 22d. With passage of the trough, a strong mass of high pressure advanced into southeast China and blocked further poleward movement. The typhoon responded by turning sharply westward.

Navigating the Luzon Strait during the 23d, Della's center shifted southwestward and skirted the Luzon coast near Cape Bojeador. During this period, strong, gusty winds swept the northern Luzon coastline. Aparri measured a gust to 85 kn from the south after center passage, while Laoag reported southwesterly winds gusting to 56 kn. Vigan, on the west coast, received the heaviest 24-hr rainfall. Only slight damage occurred in the Philippines, because the center avoided landfall.

Charting a westward course across the South China Sea as a relatively small typhoon, Della intensified steadily. A Japanese ship, the YAMAMIZU MARU, encountered winds of 60 kn southeast of the center, at 0600 on the 24th, while the Israeli ship NURITH reported 60-kn winds as it crossed west of Della's eye 12 hr later, at 1800. Aircraft reconnaissance of Della, on the 25th, measured a central pressure of 958 mb at 0456, within a tight eye 15 mi in diameter. This was the lowest pressure recorded during the storm (fig. 26).

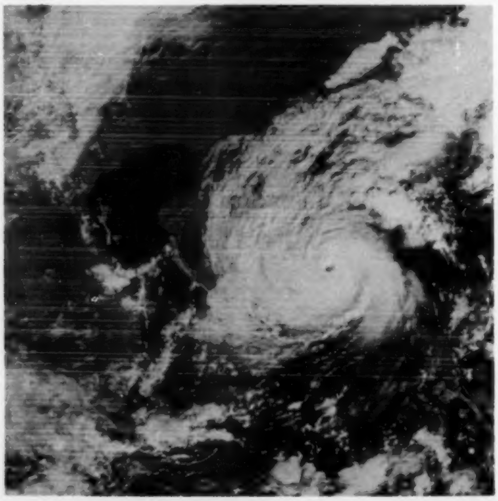

Figure 26.--Typhoon Della near peak intensity in the South China Sea, 280 mi south of Hong Kong, October 25, 1974, at 0025. DMSP Imagery.

Intensity estimates from satellite data suggested that Della had weakened slightly, before landfall on Hainan Island on the 26th. Emerging into and crossing the Gulf of Tonkin, the storm never regained its former intensity. Following coastal crossing of North Vietnam, early on the 27th, the circulation weakened and subsequently disappeared from synoptic analyses.

TYPHOON ELAINE

Elaine, the largest of the typhoons to traverse the Philippine Sea during October, was upgraded from tropical depression status, early on October 25, about 550 mi northwest of Guam. Developing from a circulation in the monsoon trough near Guam (the fourth to form in the trough during October), the envelope of Elaine's 1000-mb isobar eventually grew to 500 mi in diameter, prior to striking Luzon a week after initial detection. During this period, Elaine intensified markedly, as aircraft reconnaissance of the typhoon, 12 hr prior to striking Luzon, observed a central pressure of 943 mb and 700-mb flight-level winds of 110 kn.

The same high-pressure regime that forced Della on a westerly track through the Luzon Strait, on the 23d, extended eastward and, late on the 24th, blocked Elaine (as a depression) from any further poleward movement. For a period of 3 days, Elaine was influenced by this ridge of high pressure to the north, forcing the typhoon on an atypical westerly heading across the Philippine Sea--an anomalous track for October tropical cyclones developing near the Marianas and normally following a northward recurving course.

Elaine, the most severe typhoon to strike Luzon this month (fig. 27), brought strong winds over a large expanse of the northern Philippines. Inland, Tuguegarao City observed a minimum pressure of 958.7 mb, at 2300 on the 27th, and peak gusts to 96 kn, as the center passed south of the station. The west coast station of Vigan recorded a minimum pressure of 972 mb, with an extreme gust of 100 kn, at 1100 on the 28th, as the center emerged into the South China Sea. Newspaper reports indicated the winds were strong enough to lift a new, galvanized-iron roof off a centuries-old cathedral in Vigan. Manila (180 mi to the south) received gusts to 43 kn. Baguio experienced extreme winds of 76 kn, when the center passed 70 mi to the north.

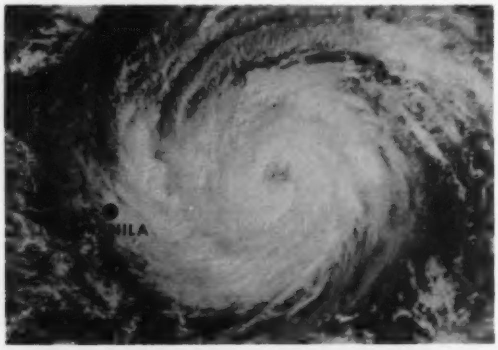

Figure 27.--Massive typhoon Elaine, 300 mi east of Luzon, 1 day prior to the center striking the island, on October 27, 1974, at 0015. DMSP Imagery.

Elaine brought 24-hr rainfall totals of 3 to 4 in to northern Luzon, while Manila reported 10.5 in. An extreme 24-hr amount of 32.2 in was reported at Baguio. The heavy rains, combined with those of Della several days earlier, left most farmlands under water.

Damage was extensive in Luzon, with estimates of losses to crops and private and public properties amounting to $21 million. Thousands of homes were destroyed or damaged, with some 300,000 persons left homeless. A total of 23 persons were listed as killed, 14 of whom were lost when swept off a ferryboat in the Sibuyan Sea.

Maritime casualties were high, as 20 Philippine fishermen were counted missing in coastal waters. At sea, the 39-ton Japanese vessel KOSHU MARU sank east of Luzon, with its crew of 11 presumed lost. The 3,800-ton Korean ship MOKPO reported flooding and serious damage near the Luzon Strait.

Elaine turned westward, then west-northwestward, while moving across the South China Sea, as the region of high pressure dominating China weakened. During the 28th and 29th, the typhoon's circulation brought strong winds to several merchant vessels. The highest values reported were from the Japanese vessel OLYMPUS MARU, which experienced 50 kn west of the center, on the 28th at 1200, as Elaine was emerging from the Luzon coast, and later from the Russian ship ALEXANDER IVANOV, which also reported winds of 50 kn, on the 29th at 1200, 120 mi north of the center. Pratas Island observed sustained (10-min) winds of 45 kn, as Elaine's center passed 120 mi to the south on the 29th.

As the typhoon advanced northwestward, pressure over South China continued to fall, causing Elaine to slow to almost a stall, 90 mi south of Hong Kong, late on the 29th. At this time, an onset of northeasterly monsoon flow influenced Elaine's circulation, with subsequent filling and rapid weakening of winds about the center to storm strength. By the 31st, Elaine was reduced to a tropical depression and forced southwestward by an advancing high-pressure ridge over South China. One day later, the circulation dissipated southeast of Hainan Island.

During the cyclone's close proximity to Hong Kong, Elaine brought gale-force winds to the Colony. The Royal Observatory registered a gust to 52 kn, while winds peaked to 55 kn on Wanglan Island. A 2-day (30th and 31st) rainfall amount of 8.6 in was measured at the Royal Observatory, when Elaine stalled offshore.

TYPHOON GLORIA

Gloria, like Elaine, developed a large circulation, with her 1000-mb isobar reaching 400 mi in diameter while traversing the Philippine Sea. Gloria, however, developed to these dimensions early in her life, as the storm reached typhoon force 50 mi north of Yap Island on November 4. Earlier, Gloria had developed from a depression in the active monsoon trough and passed about 10 mi northeast of Yap Island. The island's weather station registered a minimum pressure of 985.7 mb, at 2020 on the 3d, and later a peak gust of 46 kn, as winds shifted to the west.

The building of a strong surface ridge southwest of Marcus Island subjected Gloria to a tightening gradient and strengthening flow in the right semicircle. Strong winds were observed at a considerable distance to the northeast, with Andersen AFB, Guam, 350 mi from the center, observing gusts to 46 kn, at midday on the 3d.

Gloria commenced an unusual acceleration in forward speed of up to 24 kn during the 4th--twice the normal for the area. Moving some 500 mi in 24 hr, Gloria occupied the central Philippine Sea early on the 5th. The FREDERICK LYKES, caught west of the center, at 0000 of the 5th, reported northwesterly winds of 60 kn, while the barometer dipped to 983.4 mb.

Rapid deepening occurred once typhoon force was attained, early on the 4th, as Gloria's central pressure fell at a rate of 2.3 mb/hr during the rest of the day, culminating in a minimum of 937 mb, at 0400 on the 5th. Aircraft reconnaissance of the central core region, early on the 5th, proved extremely difficult as the eye diameter was only 4 mi. The typhoon's central pressure rose to 955 mb during the next 12 hr, as Gloria's forward motion slowed temporarily to 10 kn. Following the rapid filling process, the typhoon's central pressure began an unusual second deepening, as Gloria once again increased in forward speed (15 kn), targeting in on northern Luzon. The last aircraft reconnaissance of the typhoon in the Philippine Sea was 10 hr before landfall and revealed that Gloria had strengthened markedly--700-mb flight-level winds of 120 kn during penetration, and a minimum pressure of 931 mb, at 0916 on the 6th. This was the lowest pressure recorded during the year (fig. 28).

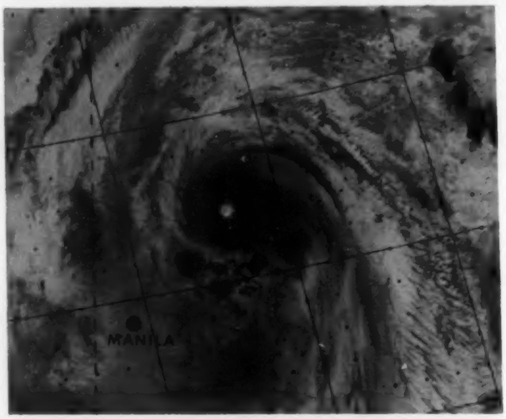

Figure 28.--Nighttime infrared coverage of typhoon Gloria reaching peak intensity, 120 mi east of Luzon, at 1117 on November 6, 1974. Cirrus canopy is absent, exposing a 20-mi-diameter eye. Darkest shades of gray represent coldest temperatures. DMSP Imagery.

Following landfall, Gloria cut across Luzon in 6 hr. Maximum winds recorded during the cyclone's passage occurred at the northern coastal station of Aparri, which reported gusts to 96 kn from the northeast, and Vigan on the west coast, registering south-southwesterly winds peaking at 94 kn. Laoag received winds gusting to 81 kn prior to Gloria's emergence in the South China Sea. The island town of Tuguegarao, 20 mi south of the center's path, observed the lowest pressure--972.9 mb. Rainfall amounts for a 24-hr period ranged from 3.8 in at Aparri to 7.8 in at Tugue-

garao, while Baguio reported an extreme of 18.9 in.

Gloria climaxed a series of five typhoons which affected Luzon in less than a month--a record frequency dating back to 1945. Newspaper reports indicated $3.2 million in damage to crops and public and private property, as a result of Gloria. Over 700 homes were destroyed by wind or inundated by floodwaters, leaving close to 1,000 persons homeless. A casualty toll of 10 persons was reported in the typhoon's wake, mostly due to drownings.

As Gloria exited Luzon into the South China Sea, on the 7th, its forward motion slowed, and a gradual track to the north commenced, as surface pressures were anomalously low over South China. However, like Elaine, Gloria failed to reach the China coast. A massive high-pressure area from Manchuria began to penetrate into central China, on the 9th, blocking further northward progress. The influx of modified air off the mainland due to the onset of a northeast monsoon began to affect Gloria, by midday of the 8th, as the circulation dropped in intensity to storm force. Reduced to a tropical depression by the 9th, Gloria began to drift southward and dissipated, on the 10th, as pressure continued to build over South China.

During the storm's transit of the waters west of Luzon, during the 7th and 8th, some of the highest winds reported by merchant vessels during the year occurred. Winds of 65 kn were reported from the British vessel MYCE, at 1200 on the 7th, and the Kuwait ship ARABIYAH, at 0000 on the 8th, as both vessels passed within 60 mi of the eye.

TYPHOON IRMA

The year's last typhoon, Irma, terminated the barrage of late-season typhoons striking Luzon Island of the Philippine Archipelago, during October and November.

Initial development of Irma took place south of Guam, as a depression in the monsoon trough, and passed north of Ulithi Atoll on November 22. Irma's circulation intensified rapidly and produced typhoon-force winds, late on the 23d. Like Elaine and Gloria, Irma's circulation dominated the Philippine Sea, with the diameter of the 1000-mb isobar extending about 450 mi by the 23d. The central pressure of the typhoon plummeted after passage of Ulithi, until a minimum of 939 mb was recorded by aircraft reconnaissance 3-1/2 days later, at 0635 on the 26th (fig. 29). Sustained surface winds generated around Irma's eye were estimated to be 115 kn, during the 26th, as the typhoon reached its peak intensity, 400 mi east of Luzon.

Late on the 25th, a massive high-pressure ridge extended eastward from China to the Ryukyu chain and prevented further poleward movement by typhoon Irma, which was near latitude 16°N. This ridge dominated the region north of the typhoon through the 27th, forcing Irma on an almost straight westerly track until she crossed the coast of Luzon. The turn of Irma to the west was again very unusual. After reaching such a poleward latitude in the Philippine Sea, few November typhoons fail to curve to the north.

Of the ships caught in the typhoon's gale-force wind area in the Philippine Sea, the vessels MIKUNISAN MARU (200 mi west of the center, at 1200 on the 25th) and ORENDA BRIDGE (a British ship 200 mi northeast of the center, at 0000 on the 26th) both reported 45-kn winds.

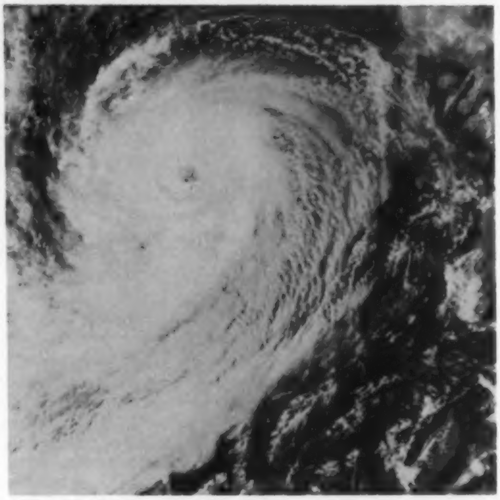

Figure 29.--Massive typhoon Irma in the central Philippine Sea, 500 mi east of Catanduanes Islands. DMSP Imagery.

Maritime casualties included several ships caught in heavy seas produced by Irma's peripheral winds. The Liberian ship PACIFICOEVERTT ran aground near Siarago Island in the southern portion of the Philippine Archipelago, while the Singapore ship FUSAN met the same fate at Nazasa Bay on Subic Bay. Reports from Catabato, Mindanao, indicated the Philippine vessel ZAMBOANGA CITY capsized and sank offshore, but all the crew survived. Not so fortunate was the Panamanian ship GREEN HILL, which sank after the cargo shifted, 60 mi north of Miyako Jima in the Ryukyu chain. Of a crew of 20, 4 were lost.

Striking Luzon, early on the 28th, the eye of Irma crossed the coastline 30 mi south of Baler, passing directly over Clark Air Base, and later exited Luzon near Iba on the west coast. Peak gusts of 74 kn and a minimum pressure of 983.9 mb were experienced at Baler. Later, Clark AB recorded a barometric reading of 979 mb in the eye (fig. 30), at 0700 on the 28th, while registering a peak gust of 83 kn from the northwest at 0500. This was the highest recorded gust at Clark AB since before World War II. As Irma's eye emerged on the west coast, east-southeasterly winds peaking at 58 kn occurred at Iba, and the pressure fell to 983.5 mb.

Twenty-four-hour rainfall totals from Irma generally varied from 2 to 5 in over Luzon, with an extreme of 6.7 in recorded at Cubi Point Naval Air Station. This amount broke previous station records for the month of November (previous 24-hr maximum was 5.3 in).

Irma brought strong gale-force winds to the metropolitan area of Manila. A gust to 51 kn from the southwest was reported at the international airport, while the port area experienced westerly winds gusting to 60 kn. Several ships in Manila Bay were reported blown almost to the Roxas Boulevard seawall during the seige.

Damage to public and private buildings, public

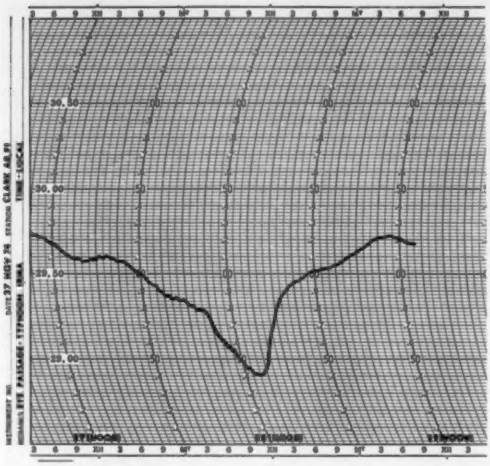

Figure 30.--Pressure trace showing passage of typhoon Irma at Clark AB.

works, crops, and livestock was estimated at $7.3 million. Over 1,000 homes were reported destroyed or partially damaged by the winds. Newspaper reports indicated Irma claimed 11 lives, in addition to sinking several small vessels and fishing boats.

As Irma departed Luzon, the ridge of high pressure over South China weakened, allowing the cyclone, then of tropical storm strength, to take a slight poleward motion during its track across the South China Sea. Late on the 29th, pressure began to fall over southwestern China, as remnants of a tropical depression (formerly T.C. 30-74) moved into the area from Burma. Irma briefly regained typhoon strength during this period, and abruptly turned toward the north, on the 30th, passing over the Paracel Islands. A meteorological station in the islands observed a pressure minimum of 970.5 mb, at 1200 on the 30th, and sustained winds of 60 kn, as the winds shifted from the west at 1500. Based on available records since 1945, no tropical cyclone has been as intense as Irma so late in the season in the northern South China Sea.

Passing abeam of Hainan Island on December 1, Irma dropped below typhoon strength and rapidly filled while approaching the South China coast. Tracking 30 mi west of Hong Kong, the circulation dissipated inland on the 2d. Maximum rainfall brought to Hong Kong by the weakening storm was 7 in, recorded at the Royal Observatory during the 2d, while southerly winds gusting to 34 kn were observed at Cheang Chau. It is noteworthy to mention that Irma was the latest tropical storm on record to affect the South China coast.

CENTRAL NORTH PACIFIC TROPICAL CYCLONES, 1974

The 1974 hurricane season in the central Pacific followed a pattern similar to that of recent years--short, but active. In general, there also was a similarity in life cycle and track with previous years' storms (fig. 31).

Between August 9 and 30, three tropical cyclones posed a possible threat to the Hawaiian Islands. The first of these, tropical depression #11, after formation near 12°N, 133°W, drifted westward as a weak tropical depression, but never reached storm strength. It passed 140°W, on the 8th, and died a few days later.

Tropical storm Olive formed in the Intertropical Convergence Zone, on the 21st, near 10°N, 147°W. It barely attained storm strength, on the 23d. It moved west-northwestward, ending its short life 240 mi southeast of Johnston Island, on the 26th.

Hurricane Ione developed off Central America and traveled westward, crossing 140°W, on the 23d, as a hurricane at 13°N. It had maximum winds of 100 kn, shortly after turning sharply northward on the 25th. It slowly curved northeastward and appeared to be heading for a quick ending over the colder eastern Pacific waters, but instead it slowly turned northwestward as the high-pressure ridge north of it strengthened. It weakened to a tropical storm and reached its highest latitude of 19.5°N, on the 27th, before swinging southwestward and further weakening to a tropical depression. Its career ended, on the 30th, 170 mi south-southeast of South Point, Hawaii Island. The eastern Pacific life cycle of Ione is described in the March 1975 issue of the Mariners Weather Log.

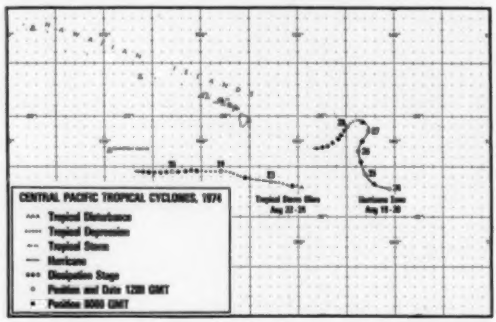

Figure 31.--Tracks of central Pacific tropical cyclones, 1974.

Hints to the Observer

SHIP REPORTS AND THE SHIFTING SANDS OF TIME

Robert G. Quayle
National Climatic Center, NOAA
Asheville, N.C.

Climatic change is a topic of great concern at the present time. Food production is closely linked with the weather, and nothing is much more basic to human survival than having a dependable food supply--witness the catastrophic effects of recent climatic fluctuations in Africa, the El Nino of Peru, and our own "dust bowl" of the 30's.

In order to monitor the environment and assess climatic change, scientists must first have basic observational data covering long periods of time. The data collection must be continuous; there is never "enough" because we must continue to monitor the heartbeat of world weather in order to continuously assess the health of the world's environment. If we are fouling our own nest to the extent that the climate is changing, we must have an early warning system. In fact, knowledge of climatic change is desirable, no matter what the cause.

What has this to do with Ship Reports? PLENTY!

Seven-tenths of the world is ocean, so 70 percent of the world's weather occurs over the oceans. This factor cannot be neglected in worldwide climatic assessment. In addition to being great energy reservoirs for feeding the world's weather, the oceans are very conservative and tend to dampen out many of the smaller weather fluctuations, thus making them good indicators of long-term change.

True satellites, buoys, and other exotic sensing media have added greatly to the general availability of data, but ground-truth observations are still badly needed, and this means ship reports. The unshaded ocean areas of figure 32 show where a critical shortage of marine reports exists. As you can see, the sparse-data area is huge, and thus the resulting gaps in scientific knowledge can be expected to be correspondingly great. In addition to the large data-sparse areas, near-coastal areas need better observational coverage.

What can be done? S.O.S.

Take high-quality observations regularly. These observations will be of great value, particularly when they are from data-sparse areas. Take observations even if you cannot transmit them. And remember, if you are in a data-sparse area, observations may be transmitted up to the time they are 12 hr old (the normal limit is 3 hr). By cooperating in this program, you will help real-time analyses and forecasting, and your grandchildren may be very grateful.

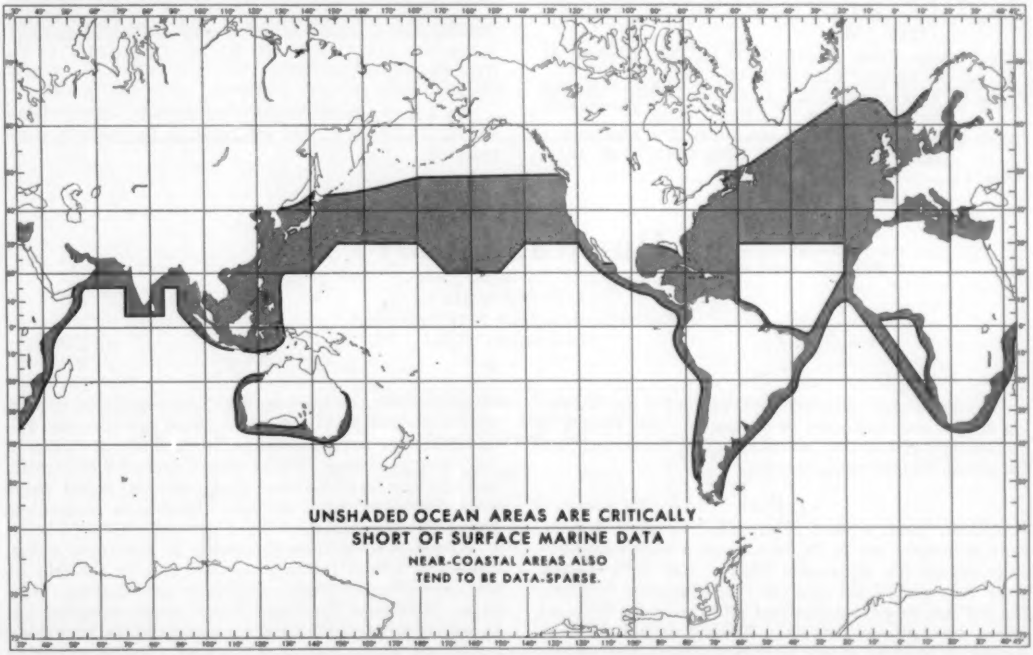

Figure 32.--The unshaded ocean areas are data-sparse. Observations from these regions are of vital importance to many studies.

Tips to the Radio Officer

Warren D. Hight
National Weather Service, NOAA
Silver Spring, Md.

CORRECTIONS TO PUBLICATION, WORLDWIDE MARINE WEATHER BROADCASTS

Page 9--Saint John, New Brunswick, Canada (VAR): Delete A1 broadcast.

Page 13--Ocean Gate, N.J. (WOO, WAQ): Revise "Area affected" to read:
(a) Offshore waters: 32°N-41°N, west of 65°W (West Central North Atlantic).
(b) Offshore waters: north of 41°N, west of 60°W (New England Waters).
(c) Coastal waters: Block Island, R.I., to Virginia Beach, Va.
Revise the description of the 0100 and 1300 A3A, high-frequency broadcasts to read: "Forecast and warnings for area a. Synopsis for area b if time allows." Amend description of the A3H broadcast on 2558 kHz to read: "Forecast and warnings for areas a and c."

Page 16--Norfolk, Va. (NAM): The station has discontinued transmitting Parts 4 and 5 (ship and coastal reports). Delete all reference to these parts. Delete footnotes 4 and 5, and the list of coastal and island stations.

Page 22--New Orleans, La. (WNU): Add frequency 17117.5 kHz.

Page 24--San Juan, Puerto Rico (NMR): Change A1 broadcast time from 0020 to 0120.

Pages 48 & 49--Cold Bay, Alaska (KCI 95): Change broadcast time "0335" to "0535."

Pages 48 & 49--Kodiak, Alaska (NOJ): The A3H broadcasts on 2670 kHz at 0200, 0445, 0900, 1415, 1645, and 2100 GMT are also transmitted on frequency 6521.8 kHz (A3J). Broadcasts cover areas 2, 3, 4, 5, 6, and the Gulf of Alaska.

Pages 48 & 49--Alaska: Add details for new broadcast from Coast Guard facility at Lena Point, Alaska: 0130, 0830, 1330, 1900; Lena Point (Call letters unknown): 2670 kHz; A3H; synopsis, forecasts, and warnings for area 1.

Pages 48 & 49--Alaska: Insert following new broadcasts: 0230, 1630, 2100; Juneau (WGG 58); 2400 (A3); forecasts and warnings for area 1.
0230, 1630, 2100; Ketchikan (WGG 56); 2400 (A3); forecasts and warnings for area 1.

Page 103-Boston, Mass. (NMF): The wind and sea height/surface analysis chart transmissions have been discontinued. Delete all information relative to these charts.

CORRECTIONS TO PUBLICATION, RADIO STATIONS ACCEPTING SHIPS' WEATHER OBSERVATIONS

Page 5--Delete WAX, Miami (Ojus), Fla.; station closed.

ACKNOWLEDGEMENT OF RADIO OFFICERS' CORRESPONDENCE

We want to thank Mitchell S. Rebich, REO, SEA-LAND EXCHANGE, for information he recently contributed.

Hurricane Alley

Dick DeAngelis
Environmental Data Service, NOAA
Washington, D.C.

The excellent, detailed information for the following report was furnished by J. Speich. Mr. Speich is a meteorologist for the Meteorological Service of New Caledonia and its dependencies.

ALISON

Alison, born a weak depression in early March, rose to become one of the most severe hurricanes ever to ravage the Melanesia Chain. Her main targets were New Caledonia and the New Hebrides Islands. She hit the New Hebrides just after reaching tropical storm strength on the 4th. Winds over these islands gusted up to at least 60 kn. The skipper of the NARCISSA CUGOLA, aground on Emae Island, estimated gusts of hurricane force and observed a low pressure of 984 mb. Rains over several days totaled up to 9 in; they were heaviest on the 5th. Wind and rain was responsible for severe damage within a 60-mi radius of the storm's center. Trees were knocked down, roads and bridges were washed away, several small ships were driven aground, and some houses on Tongoa and Emae were unroofed.

Alison reached New Caledonia as a hurricane (fig. 33). The island felt most of her fury on the 7th, as she entered near Touho and left by way of Cape Goulvain. Sustained hurricane-force winds extended out about 50 mi from Alison's center, while hurricane gusts punished most of the island. Touho recorded the lowest pressure--942 mb. Baie Ugue recorded sustained winds of 103 kn, with gusts to 119 kn. They

Table 5
TROPICAL CYCLONE DATA
HURRICANE ALISON
March 3-10, 1975

Station	Date	Pressure (mb)		Wind (kn)				Rainfall total (in)	Time+	Remarks
		Low	Time+	Average maximum	Time+	Gusts	Time+			
New Hebrides										
Emae	4	984.0	2130			69-76*				Several roofs damaged.
Lamap	4	988.8	5/0030	240°/48	1940	WSW 56	1940			Maximum rainfall intensity 3.8 in from 5/1630 to 5/1730.
Bauerfield	7					N 47	0130,0230			
Tanna	7			040°/44	0730	NE 51	0730			
Anatom	8			030°/45	0300	NE 51	0400			
Port-Vila	5	996.8	0415					5.9	4/1230-6/1430	
New Caledonia and dependencies										
Touho	7	942.0	0815	100		/116				
Poindimie	7	967.6	0915	73		130°/83	0440	14.8	March 3-9	Maximum 24-hr rainfall amount 10.8 in on the 7th.
Baie Ugue	7			103		090°/119	0720			
Koumac	7	983.2	0510	68		180°/78	0440	5.1	March 3-9	Maximum 24-hr rainfall amount 3.4 in on the 7th.
La Tontouta	7	981.9	1700	46		060°/54	1310	6.8	March 3-9	Maximum 24-hr rainfall amount 4.8 in on the 7th.
Noumea	7	984.5	1730	62		120°/72	0845			
Ouanaham	7	995.2	0630	52		040°/60	1025	6.6	March 3-9	Maximum 24-hr rainfall amount 4.3 in on the 7th.

* Estimated
+ GMT

Figure 33.--Beautiful, but dangerous, Alison is blanketing both New Caledonia and the New Hebrides under her circulation on the 6th.

also reported a 10-min average windspeed of 92 kn. Heavy rains fell over the island from the 3d through the 9th, with totals of 5 to 15 in. They were torrential on the 7th. Touho recorded 10.8 in that day, and 3- to 5-in totals were common. Winds were strongest along the east coast, where buildings were destroyed or damaged, telephone lines blown down, and many coconut palms uprooted. The heavy rains produced devastating floods over the whole island. While the rainfall was not exceptional for tropical cyclones in this region, it fell on land that was nearly saturated from previous rains, so that many creeks and rivers were already at abnormally high levels. In general, the rivers rose 6 to 20 ft in the east and south, and from 25 to 35 ft near the storm path. In one valley, a maximum rise of nearly 60 ft was observed. While the islanders suffered no loss of life, their crops and homes were devastated. Table 5 summarizes the meteorological conditions.

After leaving this destruction in her wake, Alison continued southward. By the 9th, she was considered extratropical. This did not prevent her from dump-

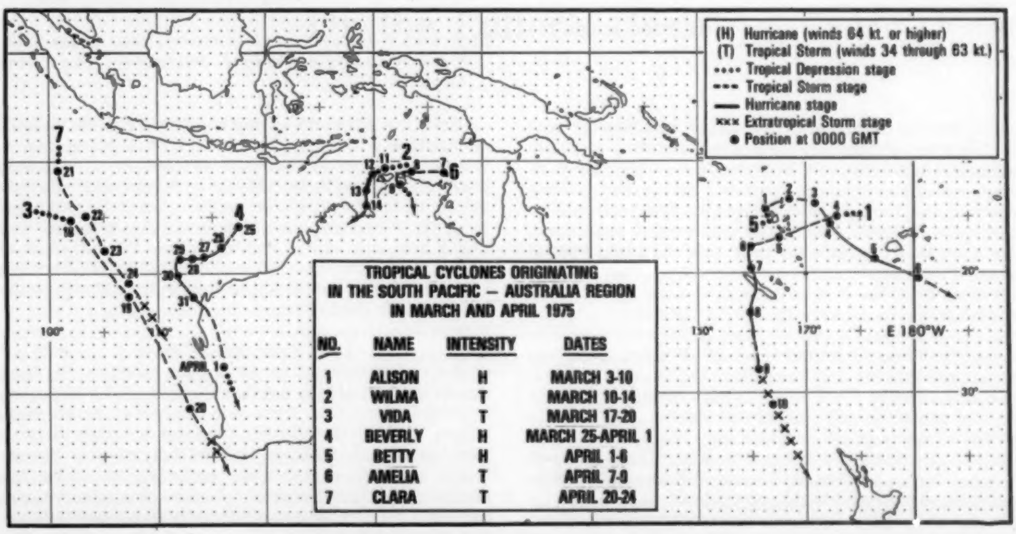

Figure 34.--Tropical cyclones originating in the South Pacific-Australia region, in March and April 1975.

ing heavy flood-producing rains over New Zealand a few days later.

March is usually the last big tropical cyclone month in the Southern Hemisphere, roughly comparable to October in the North Atlantic. On the average, two to three tropical cyclones roam the South Indian Ocean, while three or four raise havoc in the South Pacific-Australia region. Activity tails off in April, with one or two storms in each area. This year, the South Pacific-Australia region was active, with four tropical cyclones in March and three in April. South Indian Ocean waters were quiet, with one storm in each month. Activity is usually slack in the North Indian Ocean during these months, and was. Tracks of the storms are shown in figures 34 and 35.

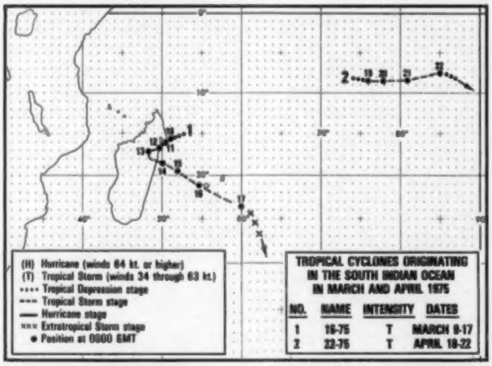

Figure 35.--Tropical cyclones in the South Indian Ocean, in March and April 1975.

SOUTH PACIFIC-AUSTRALIA REGION

Two tropical storms, Wilma and Amelia, affected northern Australia. Wilma was first detected just northeast of the Cobourg Peninsula on March 10. Before reaching tropical storm strength, she moved westward past Melville Island and then turned southward into the Joseph Bonaparte Gulf. On the 13th, Wilma reached minimal tropical storm strength, but, by the following day, she was inland and weakening. Amelia formed in the same area the following month. On the 7th, she was spotted near Wessel Island. She was also a short-lived, minimal tropical storm that hugged the coast while moving westward. On the 8th, Amelia turned southward after crossing the Cobourg Peninsula. She moved inland east of Darwin.

The three tropical cyclones that roamed the seas off Western Australia affected weather along several shipping lanes; one reached hurricane strength. Vida and Beverly formed within a week of each other in March, while Clara came to life in late April. (The name Amy was used for a small, subtropical LOW that flared up briefly in the waters around 20°S, 70°E, from the 19th through the 24th.) Tropical storm Vida, developing on the 17th, moved rapidly south-southeastward for several days before becoming extratropical as she passed just off Cape Leeuwin on the 20th. She was then enveloped by a potent extratropical storm on a circumpolar route along the "roaring forties." Vida's maximum winds were estimated at 50 kn, as she passed west of Perth on the 20th. Beverly was the hurricane. She caused a few problems to shipping toward the end of March. The NIIHAMA MARU, on the 25th, and the MEIKO MARU, on the 29th, both encountered 30-kn winds, 120 to 180 mi northeast of Beverly's center. The GQUJ, just northwest of the center on the 27th, ran into 40-kn southwesterlies. At this time Beverly was already a hurricane. She reached her peak on the 29th, when maximum sustained winds were estimated between 100 and 120 kn (fig. 36). On the 31st, Beverly moved onshore about 100 mi southwest of Onslow, where 45-kn winds were blowing at map time. Beverly weakened as she continued overland for the next 2 days. Clara formed, on April 20, about 300 mi southwest of the Sunda Strait. Her circulation was evident even up to 240 mi to the northeast of her center, where WANDERLURE reported a 25-kn northerly wind the following day. Clara was a tropical storm from about the 21st to the 24th. She started to turn extratropical and weaken before reaching the coast of Western Australia.

Figure 36.--Close to peak intensity, late on the 28th, Beverly is edging toward Australia's Northwest Cape.

Betty got her start among the New Hebrides Islands on April 1. Moving eastward, then southeastward, she developed over the next several days, reaching hurricane strength by the 4th. Winds near Betty's center were 65 to 70 kn during the next few days' journey, which brought her close to the Fiji Islands. The CGZF ran into 24 hr of gales, some 250 mi south of the center on the 5th, while another ship encountered 45-kn winds just southeast of the center. Betty weakened rapidly the following day.

SOUTH INDIAN OCEAN

A tropical storm formed in each month. The first developed just off the northeast coast of the Malagasy Republic on the 9th. It reached tropical storm strength before moving inland over the island. When it came back out, on the 13th, it was still a tropical storm. Winds near the center were estimated at 45 kn, but conditions were not right for further development. On the 17th, the weakening, southeastward-moving storm turned extratropical.

The second storm was unusual in that it formed

Figure 37.--Heavy rains turned the two roads leading into the small town, of some 600 people, into rivers and washed out sections of railway track. Photo courtesy of The West Australian.

Figure 38.--Damage was done to about two-thirds of Onslow's buildings, including this prefabricated schoolroom, which was erected 2 wk before the blow. Photo courtesy of The West Australian.

and remained north of 10°S, and that it moved toward the east. Maximum winds reached 50 kn near the center on the 21st. By the following day, the storm was weakening.

ONSLOW REVISITED

In the last issue of the Log, we reported that Trixie, generating 100-kn winds around her 930-mb center, crashed ashore near Onslow, Western Australia, on February 19. We recently received some pictures (figs. 37 and 38) of the Onslow damage, courtesy of James Payne of the Australian Embassy, which were taken by The West Australian newspaper.

Severe tropical cyclones and devastation are nothing new to Onslow. In the twenties, the original town was destroyed by a hurricane and rebuilt at a new site. It has been estimated that the town has been ravaged 10 to 12 times in the past 90 yr. On March 15, 1958, Onslow recorded a 109-kn gust, to tie Willis Island's record for Australia, set the year before. The town had warmed up by recording a 93-kn gust, 11 days before. In 1961, she recorded a 104-kn gust (January 25) and a 90-kn gust (March 1) and suffered heavy damage from the two severe cyclones that produced these winds. Then, on February 7, 1963, Onslow became the champ, as a tropical cyclone belted the town with gusts to 125 kn. Not content with basking in this dubious glory, she has recently submitted her entry of a 133-kn gust from Trixie. This is being evaluated.

On the Editor's Desk

NEW PORT METEOROLOGICAL OFFICER

Just prior to the publication deadline, it was announced that Lawrence Z. Cedotal has been named as the Port Meteorological Officer for Nederland, Tex., replacing David Harmon. Also, the new telephone number for the PMO at Nederland is 713-722-1152.

ARCTIC ENVIRONMENTAL DATA BUOYS DEPLOYED BY U.S. AND CANADIAN SCIENTISTS

NOAA has announced that 10 automatic data buoys were deployed in the Arctic ice this spring as part of the National Science Foundation's Arctic Ice Dynamics Joint Experiment (AIDJEX), a long-range scientific program to unlock some of the secrets of the frozen north.

The AIDJEX experiment is designed to reach, through coordinated field experiments and theoretical analysis, a fundamental understanding of the interaction between the Arctic sea ice and its environment. An understanding of sea ice dynamics could lead to safer navigation of the waters which flank the frozen north land, now a center of attention in the search for new oil and gas deposits. In addition, buoys which operate successfully in the polar regions could play an important role in weather forecasting in those regions.

Major participants in the AIDJEX program include, in addition to the National Science Foundation and the Department of Commerce, the Arctic Research Laboratory of the Office of Naval Research, the Lamont-Doherty Geological Observatory of Columbia University, U. S. Geological Survey, NASA, the University of Alaska, the Army Cold Regions Research and Engineering Laboratory, and several Canadian groups.

The buoys are stationed in the Beaufort Sea north of Alaska's North Slope, in a circle with a radius of about 185 mi, around the central AIDJEX manned camp. The precise position of each of the unmanned drifting buoys is determined several times daily with the aid of the Navy satellite navigation system.

Every 3 hr, sensors on the 340-lb buoys measure various oceanographic data, including atmospheric temperature and pressure, and ice movements. The buoys will be visited periodically for calibration and

refurbishment.

The buoys are an advanced version of buoys tested in the Arctic ice, in 1972-74, to determine the feasibility of operating unmanned, satellite-communicating, data-reporting buoys in the polar seas. Designed to operate for up to 1 yr, some of the earlier buoys substantially exceeded this, despite storms, drifting ice, temperatures of -50°F, and attacks by marauding polar bears (Mariners Weather Log, Vol. 17, No. 5).

CITIZEN-OBSERVERS SUPERVISE GREAT LAKES WATER-LEVEL GAGES

A dedicated group of citizen-observers are supervising 50 water-level gages on the Great Lakes, as high waters continue to plague America's inland seas.

The gage observers inspect the gages in all kinds of weather. Their small remuneration for services doesn't reflect their true value to the program. Among the tasks performed by observers are removing water-level records and sending them to the Lake Survey Center, installing fresh recording material, doing minor maintenance, and reporting serious malfunctions.

A variety of unique problems hinder the gage observer. One of the most serious is ice. Special heaters and heat lamps have been installed in certain key gage houses to keep the sumps ice-free. Ice formation is restricted in others by adding kerosene or diesel oil to the sump to serve as an antifreeze. Vandalism, power failures, sediment-covered or plugged inlet pipes, and the occasional need to don snowshoes in winter to get to the gage site are just a few of the difficulties encountered by gage observers.

The measuring of Great Lakes water levels by the Lake Survey Center is a precise and scientifically refined effort. Accurate water-level statistics are important to the public during periods of extreme high or low levels. Water-level information is particularly important during sustained periods of above-normal lake levels, and the observers must be especially alert to make sure recorded data are forwarded on time. The information also has a variety of other applications, such as regulating outflows from two of the Great Lakes, design and construction of shoreside facilities, and the compilation of nautical charts. Gage records sent to the Lake Survey by observers are checked and reduced by technicians, and are then issued in several different forms to hydroelectric power concerns, commercial shipping, and the public.

A water-level gage consists of four parts: 1) an inlet pipe which extends into the water; 2) the sump, or stilling well, to which the inlet pipe is connected; 3) the specialized and highly accurate recording apparatus that is float-activated, the float and tube hanging down to the sump; and 4) the shelter which provides protection from the elements and security. The level of water in the sump reflects the level of the lake at the end of the inlet pipe. As the lake rises or falls, the water in the sump will also rise or fall, with water seeking its stable level. This is the action the recording equipment measures (fig. 39).

Two types of recorders are used; the analog type which provides a continuous trace, and the digital type that records levels every 5 or 15 min. Fluctuations like storm surges and seiches are recorded, but short-term changes, such as waves, are not. Thus, during a northeast storm on Lake Erie, a report may state that the level at Toledo, Ohio, is +85 in. This would

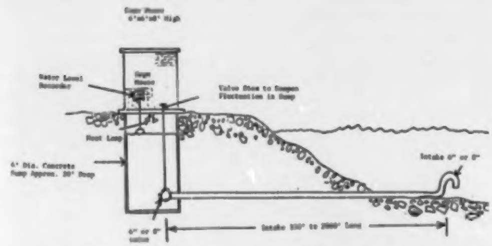

Figure 39.--Profile view of typical Lake Survey Center Great Lakes water-level gaging station.

indicate a storm surge, a raising of levels at one end of the lake by the wind. Wave height would have to be added on to the surge level to obtain the momentary level. During high-water situations, it is usually wave action (high winds creating wave action) that overtops breakwaters and seawalls causing flooding, and accelerates erosion.

Some strategically located gages are equipped with a telemetering system. This permits the gage to respond to a telephone call and to provide, by a series of signals tied to a teletype, the exact water level at that point in time. This capability is of particular value to NOAA's lakeshore warning program.

SUEZ CANAL OPENED

The Suez Canal, blocked for nearly 8 yr, was officially opened again for transiting of vessels on June 5. Two West German freighters, the MUNSTERLAND and NORDWIND, stranded in the Canal in 1967, were the first vessels to negotiate it, on May 7. According to reports, there were 12 stranded vessels in the Canal which have been towed northward to the Mediterranean.

TRANSPORTATION ACCIDENTS, 1974

Nearly 10,000 fewer persons died in U. S. transportation accidents in 1974 than in 1973, according to preliminary statistics released by the National Transportation Safety Board. Highway deaths were down sharply, and the toll in all transport modes dropped from 60,356 to 50,541. This total was the lowest in a decade, and the 16-percent reduction was unparalleled since World War II.

Highway deaths, which always account for more than 90 percent of all U. S. transport fatalities, were down 18 percent--from 55,800 to 46,200. Of these, 44,950 were highway crash fatalities, and 1,250 were deaths on grade crossings, in 1974.

Three other modes of U. S. transportation also registered substantial fatality reductions in 1974. Pipeline deaths dropped 48 percent, from 66 to 34; recreational boating deaths were down 16 percent, from 1,754 to 1,475; and railroads achieved a 13-percent reduction, from 668 to 582.

Air carrier fatalities more than doubled, rising from 227 to 467. Deaths in commercial marine accidents rose 16 percent, from 320 to 379. Totals in all other modes varied less than 10 percent between 1973 and 1974 (fig. 40).

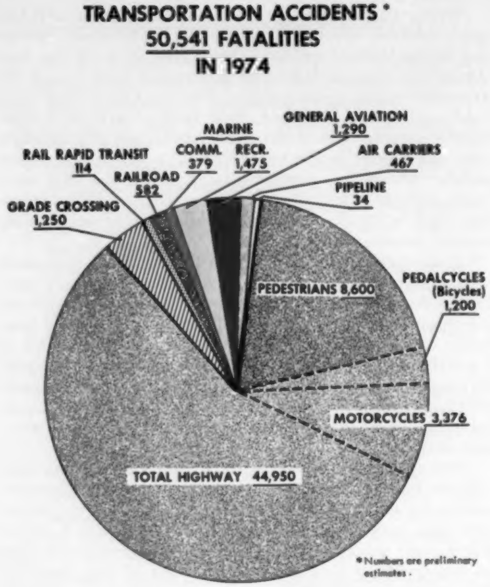

Figure 40.--Breakdown of 1974 transportation fatalities. Marine casualties were up.

NOAA REPORTS PRELIMINARY RESULTS FROM DEEP-OCEAN MINING STUDY

The environmental effects of deep-ocean mining are far from well known, but they will include stirring up sediments and disturbing bottom life, and possibly resurrecting long-dormant spores. These were among the tentative conclusions of a study in a NOAA project aimed at predicting the probable environmental impact of deep-sea manganese nodule mining: the Deep Ocean Mining Environmental Study (DOMES). The job of analyzing the data collected will take months, but the preliminary results are in, and they provide new insights into the marine environment of which the manganese nodules are an integral part.

As the first step in DOMES, scientists conducted an initial baseline study, in the spring of 1974, to begin to establish the premining condition of an area of the Pacific where mining corporations are already filing claims. For 4 wk, 17 oceanographers and technicians aboard the University of Hawaii's MOANA WAVE studied the living organisms, sediments, currents, and waters within a 20,000-sq-mi area 850 mi southeast of Hawaii. The cross-shaped study area lies in an enormous nodule zone that extends from Mexico to the Marshall Islands.

The DOMES researchers measured such characteristics as salinity, temperature, amounts of dissolved oxygen, sediment geology, phytoplankton productivity, nutrients, and trace metals at many different stations in the study area. More than a ton of the nodules themselves was collected. Four arrays of current meters were deployed at one of the stations to determine circulation patterns. An underwater camera took 2,204 photos of the sea floor. In the upper levels of the water column, the researchers measured the intensity of light penetrating below the surface. The amount of light affects the rate of photosynthesis and thus the biological productivity of the waters.

Some deep-sea mining systems would bring large quantities of bottom water and some sediments to the surface; all would stir up clouds of sediment near the bottom. How would these foreign materials disperse, and what effects would they have on the character of the waters and on life forms? The density of the bottom water after it is brought to the surface, compared to that of the normal surface water, will determine whether it stays at the surface or sinks downward again. For the most part, differences in temperature and salinity determine the relative densities of the waters. As it is transported upward, the bottom water is heated, and may in some cases reach the same temperature as water at the surface. The DOMES researchers verified that the salinity of bottom water in the Pacific study area is very close to that at the surface. This means that bottom waters brought to the surface would probably remain there.

These bottom waters would be rich in nutrients that could stimulate the growth of phytoplankton in the surface waters. To assess the effects of such an infusion of bottom water, the DOMES researchers collected water samples from 10 to 12 depths in the upper 500 ft (150 m) of water and analyzed them for amounts and species of phytoplankton. The depths sampled were chosen according to thermal structure and light penetration, or the percent of sunlight reaching a given depth compared to that at the water surface.

In the shipboard laboratory, the team made up varying mixtures of sediments, bottom water, and surface water, and incubated them for 24 hr under natural sunlight filtered to simulate the different light levels received by the surface-water samples. The results were no surprise; phytoplankton development was generally proportional to the amount of nutrient enrichment. But, deep-water discharge at the surface will probably amount to less than 1 percent of the total mixture.

Other experiments tested the effects of various benthic nutrients on samples of surface water. Thousands of analyses of nutrients, alkalinity, and oxygen content were conducted on the ship.

There was also the possibility that mining might revitalize spores that have lain dormant in the sediments for ages, spores whose natural enemies may have long since disappeared. The researchers did find a series of phytoplankton spores buried in the sediments which bloomed to life when brought to the surface and exposed to light. The spores were cultured for later identification, and specimens still survive in the laboratory.

One of the sediment samples has been analyzed and found to contain four species of foraminifera--tiny creatures with delicate calcareous skeletons--and a few individuals belonging to several other groups of organisms. The bottom samples also included an assortment of relics such as squid beaks, shark teeth, and whale earbones.

So far, a fourth of the 2,204 photographs of the bottom have been examined. The census of large animal life caught by the underwater camera includes: 111 sea cucumbers, 11 tunicates, 9 brittle stars, 9 anemones, 5 sponges, 3 sea stars, 2 rat-tailed fish,

1 bivalve, and 1 coral. About 14,000 sq yd of ocean floor is visible in these 600 photos, and it seems to have a population density of about one large organism per 120 sq yd.

At least two other ocean sites, located in areas with different oceanographic characteristics, may be subjected to similar scrutiny on a seasonal basis to complete the baseline studies. The DOMES plan is to focus on the rich North Pacific nodule zone which will probably be the first to be mined.

OMEGA NAVIGATION STATION COMPLETED

An Omega transmission station completed on Tsushima Island, Nagasaki Prefecture, went into operation recently as the world's fifth such station.

Transmitting waves with a frequency of 10 to 14 kHz, the station can serve ships within a range of about 5,000 mi (9,300 km). Other radio navigation systems, such as radar, beacon, and loran, have a service range of only up to 800 mi (1,400 km).

The station consists of a 455-m-high transmission antenna, the tallest steel tower in the Orient, and antenna wires stretched in 16 directions.

Its inauguration has completed the Japanese-based Omega Navigation System, which consists of an operation center in Tokyo and two monitor stations--one on Oshima Island south of Tokyo, and the other in Mitsushima, Nagasaki Prefecture--in addition to the Tsushima station.

With the completion of the Tsushima station, the entire Northern Hemisphere has come within range of waves transmitted by five Omega stations, including those in Hawaii and North Dakota. A ship at sea can determine its position by measuring the phase difference among radio waves from three or more Omega transmission stations.

THE SMITHSONIAN INSTITUTION'S HALL OF AMERICAN MARITIME ENTERPRISE

If all goes according to plan, visitors to Washington, D. C., during next summer's Bicentennial will find an outstanding new attraction in the National Museum of History and Technology--a hall that will bring the hint of sea-fresh breezes to travel-weary tourists. The new Hall of American Maritime Enterprise, portions of which are scheduled to open in 1976, promises to offer an unsurpassed variety of exhibits depicting the Nation's maritime history.

The hall, which will occupy an 8,500-sq-ft space, has as its nucleus the present gallery of ship models collected by the historian emeritus of the Museum of History and Technology. From this eminent collection, the exhibit will expand to cover blue-water ships, river steamers, work-a-day craft of bay and harbor, fisheries, research vessels, and the lives of those who went down to the sea in ships.

Visitors entering the hall will pass through the Discovery Pavilion, which will contain a replica of Martin Behaim's 15th-century globe -- a product of a world that viewed Cathay facing Europe. In this pavilion will be models of the NINA, PINTA, and SANTA MARIA, sailing in the formation they kept on the night of October 12, 1492. A Norse "knarr," a type of vessel which brought Vikings to North America 500 yr before Columbus, will also be displayed.

From the Discovery Pavilion, the visitor will begin a journey through time, beginning with the "Forging of the Nation" period. Here the story of the first American shipyards will be portrayed, featuring a 12-ft model of the square rigger BRILLIANT. Scaled an inch-and-a-half to a foot, this replica will give visitors a sizable view of the early American shipwright's art. An alcove in the hall will hold a three-dimension exhibit showing a curving waterfront of the 19th century, complete with five yards working on ships ranging from a small coasting schooner to an oceangoing screw steamer.

A corner of a colonial warehouse will introduce visitors to another important facet of the Nation's history--the variety and growth of American maritime commerce. Here viewers will be able to see the features of trade that epitomized a century and a half of British colonial activity. Hogsheads, tierces, pipes, firkings, and puncheons in which cargoes were shipped will be on display, and visitors will learn about tecklenburgs, bombazines, calimancos, durants, dowlas, and pulicats.

The colorful history of the Nation's seafarers will also be on display in the hall. An early evening scene complete with dimly lit streets, distant ships' whistles and foghorns, and the tune of a Salvation Army Band, will carry the imaginative museum-goer back to the typical waterfront at the turn of the century. The setting would not be complete, of course, without a tattoo "parlor," where the patterns, color pots, needles, and samples of the "professor's" art will be displayed.

Dioramas, a dramatic museum technique, will allow viewers to sample a variety of shoreside scenes. Visitors will be able to compare the sights and sounds of a heavily congested waterfront of the last quarter of the 19th century to the streamlined efficiency of container ships, the roll-on, and the LASH (lighter aboard ship).

An exhibit devoted to the Pioneers of American Steam Navigation will start the museum-goer on a learning journey which will continue to the space portraying the Age of the Engineer. Highlighting this journey will be a fully equipped engineroom of a small steam vessel, complete with triple-expansion main propulsion plant, steam pumps, evaporator, hot well and bilge, fire, and sanitary systems.

The former Coast Guard Cutter OAK, decommissioned in 1964, was the source for this display. After painstakingly dismantling the engine while the vessel was docked at the Coast Guard Yard in Curtis Bay, the Curator of Maritime Transportation oversaw the reassembling of the exhibit at the Smithsonian.

The entire plant, operated by compressed air, will execute a series of programed operations in response to an engine order telegraph. Audio aids will allow the visitor to hear the roar of the oil burner, the whine of the ventilators, the thump of the screw, and the swashing of bilge water. Olfactory effects simulating the smell of fuel oil and lubricants will complete this rendition of an engineroom in the Age of Triple Expansion.

Occupying almost one-quarter of the total exhibition space will be the story of the American inland waterways. A variety of media, including such artifacts as Colonel Stevens' original steamboat engine of 1802 and a wide variety of models of rivercraft, will relate the

SHIPS, PHOTOS, FIDDLES, AND EPHEMERAE

If you are a seaman, an ex-seaman, a shipyard or a shipping line, you may have something to give to the Hall of American Maritime Enterprise.

In return you may receive a bit of immortality. The Hall needs:

- Photos of enginerooms, forecastles, and glory holes, identified as to ship.
- 19th century ephemerae -- posters, shipping and boarding house handbills, sailors' souvenirs, and knickknacks.
- Waterfront photos from anywhere in the world.
- Wartime photos of merchant ships under attack.
- Memorabilia of maritime strikes--posters, picket signs.
- A decorated 19th-century sea chest.
- Shipping calendar art.
- Musical instruments -- fiddles, concertinas, ocarinas--made or used aboard ship.
- Old ships in bottles, and fancy work.
- Homemade games used aboard ships.
- Historic models.
- Discharges and continuous discharge books.

If you think you can help the Hall of American Maritime Enterprise, contact Dr. Melvin H. Jackson, Curator of Maritime Transportation, Room 5010, National Museum of History and Technology, Smithsonian Institution, Washington, D.C. 20560. Cash donations, which are tax deductible, may be sent to Marine Hall Fund, c/o Robert G. Tillotson, Assistant Director of Administration, National Museum of History and Technology, Smithsonian Institution, Washington, D. C. 20560. All donors will receive special cards or plaques recognizing their role in the new exhibition.

RECEIVE A PIECE OF HISTORY

In return for a modest contribution to the Hall of American Maritime Enterprise, you can receive a tangible piece of history. Models of Liberty ships, each one measuring 5 in long and containing a piece of steel from the famous vessels, are available from the Propeller Club, Port of New York. The proceeds from the sale of these models, already totaling almost $5,000, are being contributed to the Smithsonian Institution to help in the construction of the hall.

They are available in three variations: an unmounted model, $9; a wood-base model, $13; and a model encased in lucite, $15. Checks should be made out to the Propeller Club, Port of New York, 80 Broad Street, New York, N.Y. 10004.

history of inland maritime commerce. Visitors will be able to compare models ranging from the early keelboats to a magnificent 7-1/2-ft model of the Gothic masterpiece JOHN M. WHITE to the 10,000-hp diesel giants of today. Structural models will teach visitors the evolution of inland vessel construction from the classic steamboat to the modern towboats now being built in river shipyards across the nation.

Capping this portion of the hall will be a replica of a modern towboat pilothouse complete in every detail. From his vantage point at the controls of this replica, the visitor will be able to watch the 1,000-ft tow being pushed, not only through the history of the river system, but through the seasonal changes as well.

While there will be plenty of history and nostalgia to delight museum-goers at the Hall of American Maritime Enterprise, there will be a good deal of space devoted to the new directions of the maritime industry. Containerization and the integration of sea-land transport, the LASH system, harbor development, the ground-effect machine, and hydrofoils will be displayed. Included in this "System Age" exhibit will be a large model of a bulk carrier, and a display of the instrumentation of the American-built steamship MANHATTAN.

This panorama of two centuries of American maritime history will cost an estimated $1.5 million. From its conception, the hall was designed to be financed by private contributions as a gift of the American maritime community to the Nation. The Smithsonian has received gifts from many sectors, but substantial donations are still needed. To learn how you can contribute, consult the boxes above.

LETTERS TO THE EDITOR

ADDITIONAL INFORMATION ON ESTIMATING WAVE HEIGHTS

The article entitled "Extreme Wind and Wave Return Periods for the U. S. Coast" that was published in the March 1975 issue generated some comment. The authors, R. G. Quayle and D. C. Fulbright of the National Climatic Center, have submitted the following letter of explanation and clarification.

"There have been some questions involving the article 'Extreme Wind and Wave Return Periods for the U.S. Coast,' which appeared in the March 1975 Mariners Weather Log. Several of these were answered by consulting the references. Other questions involved basic disagreement with the references. In those instances, individual investigators must decide whether or not they can accept the assumptions and data bases as presented.

"Further problems are encountered in the definition of an 'extreme wave.' The complex conditions which generate the rare, but occasionally observed, 'freak' giants are nearly impossible to quantify in a precise manner because of the extreme infrequency of the phenomenon.

"The following examples (which are not intended to

be generalizations or formal proofs) illustrate some of the differences in magnitude that can be encountered when describing significant wave heights under fairly ordinary conditions. These hint, therefore, at some of the difficulties involved in defining extremes.

1. Visual observations were compiled for the period 1949-73, for the Bermuda Area (~29-35°N, 62-68°W). Hindcast data were also prepared by the Fleet Numerical Weather Central, Monterey, for the same general period. The results were as follows:

Wave height (m)	Hindcast (percent)	Observational data (percent)
Calm - 1/2m	38.7	18.1
≥ 1 m	61.2	81.8
≥ 2 m	22.0	35.8
≥ 3 m	7.5	13.8
≥ 4 m	2.3	5.7
≥ 6 m	0.2	1.2
Mean height (m)	0.9	1.7
Number of data points	50,959	68,564

2. Visual observations at 12 Ocean Weather Stations (OWS) were compared to visual estimates from merchant ships within the general vicinity (a 2° quadrangle around the OWS). The OWS observations of wave height were consistently higher (generally by a factor of about 1.1) than the merchant observations. These results are based on a very large sampling and are amazingly consistent from ship to ship and season to season.

3. Six hundred and fourteen wave height measurements from a pressure gage at Cobb Seamount (off the Washington State coast) appear to show consistently higher waves than climatic visual observations. (Data provided by U. S. Army Corps of Engineers.)

"Another more serious type of question involves use of the extreme values for design criteria of structures. The extremes in our article were considered to be possible rare extreme occurrences for deepwater conditions over thousands of square miles of ocean. A single high wave anywhere within each area would qualify for consideration within the whole area. The extremes were not intended for use as design criteria for any specific small local area. Obviously, if a costly installation is planned for some particular location, a highly detailed study must be performed for that area, considering such things as historically significant storms, sea-floor topography (if appropriate), prevailing local weather conditions, and local climatic data. Risk analyses must not only involve the location and cost of the structure, but the type of structure and potential dangers to humans. Such studies involve the combined use of meteorology, oceanography, engineering, and economics. A single site study can easily involve 100 times the cost incurred in preparation of our open-ocean, 'ball-park' climatology."

MARINE WEATHER REVIEW

The SMOOTH LOG (complete with cyclone tracks [figs. 45-48], climatological data from U.S. Ocean Station and Buoys [tables 6 and 7], and gale and wave tables 8 and 9), is a definitive report on average monthly weather systems, the primary storms which affected marine areas, and late-reported ship casualties for 2 mo. The ROUGH LOG is a preliminary account of the weather for 2 more recent months, prepared as soon as the necessary meteorological analyses and other data become available. For both the SMOOTH and ROUGH LOGS, storms are discussed during the month in which they first developed. Unless stated otherwise, all winds are sustained winds and not wind gusts.

Smooth Log, North Atlantic Weather

January and February 1975

SMOOTH LOG, JANUARY 1975--The extratropical cyclone centers that traversed the North Atlantic were much more numerous than the climatological normal. They were also shifted further to the east, especially as they entered the Norwegian Sea. The tracks into the Great Lakes were normal, but the primary climatological track along the St. Lawrence River was missing. The path from about 45°N, 45°W, toward 62°N, 10°W, was well traveled.

The shift in the storm tracks was reflected in the monthly mean pressure pattern. The Icelandic Low was shifted eastward with two centers, a 988-mb near 62°N, 18°W, and a 989-mb near 67°N, 02°E, rather than a single 997-mb center near Kap Farvel. The orientation was near normal. The 1022.7-mb Azores High was shifted, with two centers, one 1026-mb over Spain and a 1027-mb over Algeria. The pressure over the U.S. east coast was slightly above normal with a 1017-mb bubble High over New Brunswick.

The largest anomaly was negative with two minus 15-mb centers associated with the Icelandic Lows. There were two positive 7-mb centers, one over Al-

geria and the other over Labrador.

The primary low-pressure center for the Northern Hemisphere, at 700 mb, was near Somerset Island (72°N, 90°W). Surprisingly, the 700-mb center over the Aleutian Low was a minor one; three others were deeper. A closed high-pressure center was located east of Miami and north of San Juan. A general statement on the anomaly pattern would indicate negative north of 48°N, and positive south of that latitude to about 15°N.

Extratropical Cyclones--The Atlantic and its northern seas were a very rough body of water this month. The storms were numerous and severe. One of the lower pressure values for an extratropical cyclone occurred, at 0000 on the 3d, near Bjørnøya. A pressure of 937 mb was analyzed; this is equivalent to about 2,150 ft above standard sea level.

A 1014-mb LOW formed over Ohio on New Year's Eve. By 1200 on New Year's Day, it was 1004 mb, south of Cape Cod. Twenty-four hours later, it was 976 mb off Nova Scotia, and the PHOTINIA was sailing with 55-kn winds about 300 mi east of Cape May. Fifty barrels of tetraethyl lead were washed off the deck of the container ship MORMACVEGA, about 190 mi southeast of New York. The ATLANTICA LIVORNO (42°N, 54.4°W) encountered 26-ft swells, and the ANCHORAGE (37.5°N, 64.8°W) battled 30-ft seas. At 0000 on the 3d, the 979-mb LOW was near St. Mary's Bay. Behind the front and slightly ahead of a secondary trough, the LYMAN HALL (34°N, 66°W) had 45-kn gales and 36-ft seas from 340°, and 39-ft swells from 310°. The CAPE FREELS reported 50-kn winds south of Sable Island. At 1200, the AUSTRAL PILOT, near 35°N, 61°W, braved 50-kn winds, 20-ft seas, and 30-ft swells. Further along the windflow, the GNJO (32°N, 58.6°W) coded only 35-kn gales, but 30-ft seas, and 36-ft swells. By 0000 on the 4th, the main LOW broke into several centers alined north-south. One of these was near 37°N, 47°W. The CORSICANA was at 37.4°N, 37.3°W, and measured 60-kn storm winds from the southeast. No sea waves were encoded, but the swell waves were 33 ft.

A frontal wave developed, near 36°N, 66°W, at 1200 on the 5th. It deepened very rapidly and was 998 mb, near 39°N, 58°W, at 0000 on the 6th. The TOM JACOB was fighting 60-kn winds on her portside as she sailed eastward. The LOW was moving north-northeastward with little change in pressure. At 1200 on the 7th, the 995-mb LOW was about 600 mi south of Kap Farvel. The QUEEN ELIZABETH 2 was near 47°N, 46°W, and being pounded by 55-kn winds of 2°C, while the 20-ft seas and 43-ft swells hammered her starboard side. It is doubtful if any passengers were lounging on the deck. The TOM JACOB continued to have a rough voyage, with 40- to 50-kn winds and 15- to 20-ft waves.

The storm continued toward the northeast, on the 8th and 9th, with gale-force winds and moderate seas. A Polish trawler capsized off a pier at Hansholm, Denmark. Ten crewmembers died, and 17 were rescued by Danish army helicopters. On the 10th, the storm crossed the Scandinavian Peninsula and out of the area of concern.

This storm ran the gauntlet from Florida to the Norwegian Sea. It entered the arena, at 1200 on the 6th, off Jacksonville, weighing 1019 mb. It moved up the East Coast, and, by 1200 on the 8th, it was near Sable Island. Gales were reported south and east of the center. At 0000 of the 9th, the TROLL RIVER, at 35.6°N, 48.4°W, had 65-kn hurricane-force winds. At 1200, the DEFIANCE reported only 32-kn winds, at 38.7°N, 47.9°W, but the seas were 16 ft and the swells 33 ft. The drilling ship VC 8062, near 45.5°N, 55°W, piped in 50-kn winds with 25-ft swells. The track had now turned eastward, with a slight southerly component.

The storm overtook and passed the AMERICAN ACE, which was lashed by 55-kn winds, and waves to 20 ft, near 46°N, 41°W. The LEVERKUSEN, near 41.5°N, 46°W, was faring no better with 50-kn winds and 23-ft swells. Nearby, a ship reported 33-ft swells. On the 10th, the storm again turned northeastward, with only gale-force winds plotted. The 10,150-ton AFRAN ZODIAC was holed by the tug BANTRY BAY, and spilled 113,000 gallons of her fuel into Bantry Bay.

At 1200 on the 12th, the 960-mb LOW was near 60°N, 16°W. A ship near 60°N, 11°W radioed a howling 60-kn wind from the south-southwest as it headed westward. Twelve hours later, the WEATHER REPORTER measured 50-kn winds in the vicinity of 57°N, 13°W. She was taking a beating from 39-ft seas. At 1200 on the 13th, the seas were 20 ft, and the swells 36 ft. The LOW's center passed near the Faeroe Islands, late on the 13th, and was absorbed by a following LOW on the 14th.

The breeding ground of storms--the Texas-Oklahoma Panhandle--gave birth to this storm. It developed to monstrous size. Several small LOWs combined, on the 10th, and its circulation already dominated from the Rocky Mountains to the East Coast.

The center moved northward and, at 1200 on the 11th, was over western Lake Superior, at 966 mb. The first laker to feel its effect was the CHARLES M. WHITE, on Lake Michigan. The measured wind was 54 kn, with 11.5-ft seas. Six hours later, the PHILLIP R. CLARKE had good news and bad news near Milwaukee--44-kn winds, but 13-ft seas.

On the 12th, the tight gradient south of the center had moved over Lake Superior, while the center had moved over Hudson Bay. The ASHLAND, EDMUND FITZGERALD, and MIDDLETOWN measured 44- to 50-kn winds and 7- to 15-ft seas. The MIDDLETOWN had the prize-winning 15-ft seas. The storm continued moving northward and disappeared over Baffin Bay on the 14th.

This LOW developed on the outer edge of the circulation of the previous storm, on the 12th, near 45.5°N, 39°W. It traveled southeastward for the first hours, then turned northeastward as it deepened rapidly to 974 mb, near 50°N, 19°W, at 1200 on the 13th. A front had developed in its sharp, north-south-oriented trough. At 1200, there were gale-force winds on both sides of the front. At 1800, the GAGE LUND (47°N, 11.9°W) was pounded by 30-ft seas and 33-ft swells. The TALLULAH (46.2°N, 15.5°W) had 50-kn winds, 25-ft seas, and 33-ft swells, and 6 hr later, 40-kn winds and the same waves.

At about 0300 on the 14th, the LOW passed very close to OWS INDIA, which had 40-kn northerly winds, 12-ft seas, and 26-ft swells from the west. Later in the day, this LOW and the previous LOW combined into a 958-mb LOW. Ship reports were sparse, but

many land stations reported 35-kn winds as the center moved between Iceland and Scotland. As the storm moved northeastward off the Norwegian coast, it broke into multiple centers, but coastal and island stations reported winds to 45 kn, and OWS MIKE braved 40-kn southwesterlies and 21-ft seas. The 1,592-ton Norwegian SOKNATIND ran aground 12 mi southwest of Floro, Norway. The vessel cracked amidships and was abandoned by the crew. The storm continued into the Barents Sea.

A 1020-mb frontal wave was analyzed off Cape Hatteras, on the 17th. It raced northeastward and, at 0000 on the 18th, was near 44°N, 48°W, with gales up to 600 mi south of the center. Twelve hours later at 1200, the CAROLA REITH was ravaged by 60-kn westerly winds and 30-ft swells, near 46°N, 41°W. Winds of 35 to 45 kn occurred around the storm's circulation for the next 48 hr. At 1200 on the 19th, Ocean Weather Station "J" reported 39-ft seas; 12 hr later, 33-ft seas and 28-ft swells with 40° difference in direction. Coastal stations of England and Ireland were reporting gales.

At 1200 on the 20th, the 972-mb storm was at 60.5°N, 10°W, and the LEVERKUSEN, at 55°N, 18°W, was plowing into a 65-kn foaming sea and 23-ft seas. Ocean Weather Station "I" measured 45-kn winds, 15-ft seas, and 20-ft swells, while her sister, "J," suffered 35-kn winds, 23-ft seas, and 15-ft swells. Late on the 20th, the LOW center moved over the Faeroe Islands and perished near Nordkopp, on the 23d.

This 988-mb LOW appeared almost out of nowhere, at 50°N, 10°W. The chart of 1200 on the 17th indicated a ridge moving into the area, but the ridge, retrograded as a LOW to the west, moved northward. At 0000 on the 18th, OWS KILO measured 45-kn winds and seas of 36 ft. The EMS ORE, at 47.5°N, 14°W, recorded 56-kn winds and 39-ft seas.

The LOW moved over the English Channel, on the 19th, leaving gales to the west and along the western coasts.

Monster of the Month -- This is an account of a storm system, rather than the history of a single LOW, as several are involved over the storm's life cycle.

The initial circulation has its beginning west of the Queen Charlotte Islands in the Pacific, late on the 16th. The LOW crossed the Great Lakes on the 18th and 19th. By 0000 on the 19th, gale-force winds were blowing off the New England coast. At 0300, OWS HOTEL measured 58-kn winds with 23-ft seas. At 1200, the CETRA COLUMBA, near 41°N, 58°W, reported 65-kn winds with a violent rainshower, at the cold front.

At this time, a new LOW formed south of Sept-Iles, over the St. Lawrence. Forty-knot winds were blowing north and east of Newfoundland. The MONT LOUIS was near 50.5°N, 46°W, with 50-kn winds. The two LOWs were moving northward to rejoin their circulations, on the 21st, in the Davis Strait. At 1200 on the 20th, the MANCHESTER CONCORDE (47.5°N, 44°W) reported 45-kn winds, 15-ft seas, and 23-ft swells. The C.P. VOYAGEUR radioed 45-kn winds with 20-ft swells, at 1200 on the 21st.

Late that day, another center developed near 59°N, 31°W, as yet another center materialized and quickly decayed near Kap Farvel. The pressure gradient from the Labrador Sea, across the latitude band of 45° to 60°N, and the Bay of Biscay to Iceland, could have supported a windspeed of near 100 kn, but 45 kn was the highest reported, by OWS JULIETT, along with 26-ft seas and 18-ft swells.

By 1200 on the 22d, the windspeeds were almost catching up to the gradient. The LOW's 952-mb center was just south of Vik, Iceland. The SUGAR CRYSTAL was near 57°N, 23°W, with 65-kn howling winds, 49-ft seas, and 57-ft swells. Ocean Weather Station "J" was managing to stay afloat with the same 65-kn winds and 49-ft seas, but piddling swells of only 28 ft. INDIA, to the north, survived 45-kn winds, with 26-ft seas and 30-ft swells. The LENIE, near 64°N, 12°W, reported only 60-kn easterly winds, as did a land station on the east coast of Iceland. The ATLANTIC CAUSEWAY, just north of Donegal Bay, was sailing into 50-kn winds driving slight showers of hail, 16-ft seas, and 25-ft swells.

Twelve hours later, at 0000 on the 23d, the winds at INDIA and JULIETT were 45 and 35 kn, respectively, but the seas were still very high: INDIA - 30-ft seas and 45-ft swells; JULIETT - 39-ft seas.

Twelve hundred on the 23d produced another report of 60-kn winds, this time by the HENNINGSDORF, near 57°N, 20°W, with no comment on the sea condition. The SUGAR CRYSTAL, near 55.5°N, 23°W, reported 33-ft seas and 52-ft swells. INDIA was still battling 43-ft confused swells. The seas at JULIETT had decreased to 30 ft. The ATLANTIC CAUSEWAY had made little headway into 55-kn winds, with the seas and swells up to 26 ft. The 11,955-ton Swedish ATLANTIC SPAN lost one 40-ft and two 20-ft containers, at 1140 on the 23d, while near and approaching the British Isles.

On the 24th, the LOW moved across the North Sea into Norway and then on to Finland, where it only produced rain and snow.

A large LOW was moving across the northern states and was over the Great Lakes early on the 26th. Its effect was felt by the EXXON WASHINGTON, at 0000, with 50-kn winds off Wilmington, N. C. A few hours later, the LOW developed two centers; the easterly one off the coast of Maine became the center of attention. At 1200, VC 8062 was whipped by 70-kn winds while off Cape Breton Island. The pressure had plunged 9.5 mb in 3 hr. The 974-mb storm was moving up the Strait of Belle Isle and, at 0000 on the 27th, gave 60-kn winds to the ATLANTIC CONVEYOR near Cape Race. Gale reports continued as the storm moved eastward and dissipated, early on the 29th.

A large part of the reason for the demise of the storm above was this LOW, which formed in the trough of the one above, late on the 27th. It moved eastward and, at 1200 on the 28th, was 1000 mb near 41°N, 45°W. The HOECHST was near 37°N, 50°W, with 60-kn winds, but mild seas. On the 29th, the storm turned northeastward and intensified. There were no extremely strong winds reported, but 40- to 45-kn gales were widespread. The 1,600-ton British ANGMERING ran aground in Galaway Bay. Heavy weather was subsequently reported, with seas breaking over the vessel, which was severely holed.

The 0000 report of the OWS JULIETT on the 30th indicated the severity of the storm with a howling 60-kn wind. There were several subcenters by this time, which widened the circulation. The KAPITAN NOCHRIN, off the Labrador Coast, felt 55-kn winds. At 1200, the FRUBEL AMERICA, near 47.6°N, 32.4°W, also found the 60-kn isotach, while the SDZA, near 54°N, 15°W, delineated the 50-kn boundary. The storm moved into the Norwegian Sea, on the 31st, and dissipated near Jan Mayen Island. The 824-ton German trawler THUNFISCH sank in heavy seas in Pentland Firth, on the 31st. The crew was rescued.

This storm came racing out of the Midwest and should have been arrested for speeding on the New York State Thruway, as it was doing close to 50 kn as it sped across the state, on the 29th. At 1200 on the 30th, it was 972 mb near 44°N, 56°W. The VC 8062 was again lashed by 60-kn northerly winds and four-star snow. To the south, the GEORGE M. KELLER had roaring 65-kn winds and 25-ft seas and swells from the west, near 40°N, 62°W. The DAWSON, further south yet, near 37°N, 63°W, also had 65-kn howling winds, and a thunderstorm to complete the picture. The OVERSEAS ULLA estimated 60-kn winds and 20-ft seas, near 35.9°N, 73.4°W.

On the last day of the month, this 954-mb storm dominated the Atlantic from around 35°N to Iceland, and high winds were reported from Nova Scotia to Lands End. The following ships reported 50-kn winds: the AMERICAN ARCHER (43°N, 39°W) and 30-ft seas, the DOLLY TURMAN (40.5°N, 40°W) and 23-ft swells, and the CYWM (46°N, 58°W). The GEORGE M. KELLER, now at 40.4°N, 63.5°W, measured 50-kn winds and 41-ft swells. The MANCHESTER VIGOUR, near 42°N, 32°W, reported 45-kn winds, with 16-ft seas and 26-ft swells, on February 1. The TRADER (42°N, 36°W) had only 30-kn gales, but the swells were 41 ft as the trough passed. Kap Farvel suffered 60-kn, -5°C, northeasterly winds compounded by three-star snow. On the 2d, the LOW stalled near Kap Farvel and dissipated, on the 3d.

Casualties--The Liberian-registered ANDROS HILLS (21,417 tons) arrived Halifax from Antwerp, on the 6th, with weather damage. The American-registered AMERICAN ORIOLE (7,929 tons) broke loose from moorings at New Orleans, during a windstorm on the 10th, and collided with four other vessels. The 1,093-ton British freighter LOVAT (fig. 41) sank 25 mi off Lands End, when her cargo of coal shifted during high winds and seas. Eleven of 13 crewmen died after their liferaft capsized in 20-ft waves. Six were rescued by a helicopter, but four of them were dead on arrival at a hospital. The 11,249-ton Italian freighter MARIA S. had to be towed to Stavanger after losing her propeller in heavy seas off the Norwegian coast.

The 16,304-ton AMERICAN WHEAT and three tank barges under tow of the tug MARMELEE collided on the Mississippi, during fog, on the 29th. The vessel was holed and beached. The barges caught fire and broke adrift, but were later collected and the fires extinguished.

SMOOTH LOG, FEBRUARY 1975--The storm tracks were near normal this month in number and location. The major track that affected mariners was off the U.S. east coast, over the Grand Banks, and toward the Denmark Strait. This month there was more of a curve eastward prior to turning northward than climatology indicates. This also tended to divert the storms along the east coast of Greenland, rather than splitting up both coasts. There were several storms in the Mediterranean Sea, as would be expected.

The Icelandic Low was located at 58°N, 40°W, within a few miles of its climatic position (60°N, 40°W), but was much more intense, 987 mb versus 1004.3 mb. The mid-Atlantic High was normally located, but about 4 mb higher in pressure. The pressure gradient between the major pressure centers was more than double what it normally is, 37 mb instead of 16 mb. This gradient would indicate that the average winds were much stronger than usual, and the storms more intense. The high-pressure center over central Europe also had a much higher pressure. It was 1029 mb, compared to a 1018.7-mb climatological value.

These vast pressure differences were of course reflected in the anomalies. A minus 17-mb anomaly was centered near 57°N, 40°W. A positive 13-mb center was near the southern tip of Norway. The central ocean reflected a large area with a small positive value--2 to 3 mb.

The upper-air height centers were near their climatological positions, but, as with the surface, were more intense with a much tighter gradient. The slight ridge that is normally on a north-south line through the Bay of Biscay was an omega block with a closed center over the Netherlands.

Extratropical Cyclones--Monster of the Month--Giant oaks grow from small acorns. So it was with this storm, which started as a minor perturbation on a front over east Texas. The frontal wave moved eastward at about 50 kn. On the 4th, it turned northeastward. The DOLLY TURMAN, at 40.2°N, 64.8°W, en-

countered 55-kn winds and 20-ft swells. The pressure gradient off the coast was tighter than nearer the center of the storm. The storm's forward speed had slowed to 35 kn, and it had acquired a large circulation.

At 0000 on the 5th, the 944-mb center was at 49°N, 39°W, with a small subcenter of 976 mb near 42°N, 43°W. The C. P. DISCOVERER was less than 60 mi east of the center, with 60-kn winds and 39-ft swells. The LONG HOPE south of the center, and another ship west of the center, had 60-kn winds with seas up to 33 ft. West and southwest of the subcenter, the winds were even stronger. The EUROFREIGHTER (42.4°N, 45.6°W) was ravaged by 75-kn winds. Not far away, the AVEDRECHT, near 41.5°N, 45°W, had 65-kn winds. Neither reported wave heights, the seas probably being so rough and the spray so heavy, it was almost impossible to tell where the boundary was. The sea analysis showed a large area roughly bounded by 35° to 60°N, and 20° to 50°W, as having waves over 20 ft. A comma-shaped area about 5° wide, north and west of the center, indicated waves of at least 36 ft.

At 1200, the ERLANGEN was added to the club of 60-kn winds. The TEXACO BRUSSELS, ROSINA TOPIC, and the MONT LOUIS were in the 50-kn bracket. At 0000 on the 6th, the DIMITROVO and IBEFJORD, on opposite sides of the LOW, now near 56°N, 39°W, had 50- and 55-kn winds. The IBEFJORD (53°N, 43°W) reported 39-ft seas from 320°, and 36-ft swells from 280°. Kap Farvel reported three-star snow and measured 65-kn winds. It was probably in this storm that the Liberian-registered MYTHIC reportedly received heavy-weather damage to her hull.

The LOW was quickly using up its energy and was filling, almost explosively. By 1200 on the 7th, its pressure was only 995 mb, just south of Kap Farvel. Far to the south, the NEPTUN, at 37°N, 34°W, reported 60-kn winds as another LOW formed northeast of her position. Gales were still blowing over much of the area. The LOW wandered in the vicinity of Kap Farvel through the 8th, when it moved up the west coast of Greenland to finally dissipate on the 10th.

This storm originated off Cape Hatteras on the 7th. It moved along the Gulf Stream to near 43°N, 45°W, at 1200 on the 8th. Gales were now being reported south of the center. The gradient was weak to the north, with the pressure pattern broken up by three small centers strung out along 48°N.

Twenty-four hours later, the storm was 968 mb near 50°N, 38°W, and was now the main circulation across the shipping lanes. The AMERICAN LEGEND was beaten by 50-kn winds, with 13-ft seas and 25-ft swells. By 0000 on the 10th, the ATLANTIC CONVEYOR, at 48°N, 43°W, was whipped by 60-kn winds, while the LOIRE was mauled by 70-kn winds south of the center near 48°N, 37°W. A ship 180 mi farther south reported 50-kn winds and 30-ft seas.

At 1200 on the 10th, two ships whose call letters could not be identified radioed 50-kn winds and 30-ft seas. It's surprising how many ships get religion when the winds and waves get high and send in weather reports and their positions. Later in the day, the LOW's track turned southeastward as it began to fill. It again turned east-northeastward and passed over England, on the 12th, to dissipate near Leningrad on the 14th. This was one of two LOWs that managed to track from continent to continent intact this month.

The central Appalachian Mountains were a strange place to develop a storm, but that is where this one was first identified. It developed very rapidly as it moved off and up the East Coast. At 1200 on the 10th, it was 986 mb, centered south of Newfoundland, with gales (fig. 41). The AMERICAN LEGEND, on her southwesterly track, had moved from one storm into another, this time at 45.1°N, 55.3°W. She again encountered 50-kn winds against her starboard side. By 1200 on the 11th, the pressure had plunged down to 954 mb. The OTTO GROTEWOHL, northeast of Notre Dame Bay, suffered 55-kn winds. The GODAFOSS and KHIBINSKIE GORY, south of the center, fought 50-kn storms. The MANDARINCORE, in the southeast quadrant, had only 45-kn gales, but fought 36-ft seas and 41-ft swells. As the storm moved over the Labrador Sea, a ship battled 60-kn winds and 31-ft waves near 50°N, 45°W.

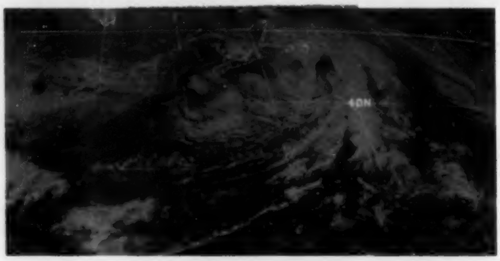

Figure 41.--The cloud streets in the cold air over the warmer water, behind the front, look like water flowing over rapids.

The center turned westward in the Labrador Sea and was stationary for about 36 hr. For over 24 hr, Kap Farvel was blasted by 55- to 65-kn winds. The storm disappeared on the 14th.

A trough that extended over eastern Newfoundland from a LOW in the Denmark Strait was the birthplace of this storm, late on the 17th. In less than 12 hr, it developed into a well-organized circulation. At 0000 on the 18th, the DART AMERICA was near 48°N, 37.5°W, about 250 mi southeast of the 978-mb center, with 60-kn winds, 20-ft seas, and 30-ft swells. The center raced northward, leaving gales and high seas in its wake. Forty-five- and 50-kn winds, with waves up to 30 ft, were reported as far as 600 mi south of the center. One of these was the AMERICAN ARGOSY, which was battered by 50-kn winds and 28-ft seas.

At 0000 on the 19th, the two Ocean Weather Stations, "I" and "J," had 50- and 40-kn winds from the south, respectively. INDIA had 28-ft seas, and JULIETT had 26-ft swells. On the 19th, the storm stalled near the Greenland coast and gradually filled until absorbed by the next LOW.

The Grand Banks produced this LOW early on the 20th. Within a few hours, it was developing gales as it moved northeastward. At 1200 on the 21st, the ALSTER EXPRESS was near 51°N, 41°W, when the 960-mb center was near 53°N, 35°W, and had 60-kn starboard winds. About 450 to 500 mi to the south, 40- to 50-kn winds were blowing with waves up to 25 ft, as reported by the ATLANTIC CHAMPAGNE, LAURENTIAN FOR-

EST, and the NORSE VIKING. The LOW raced past the eastern tip of Iceland, on the 23d, and joined another LOW to the north.

By the 21st, the upper-air support for the development of surface circulations had shifted southwestward to the familiar Cape Hatteras area. The frontal wave moved eastward and was past midocean before any significant development occurred. By 1200 on the 23d, the 964-mb storm had made its way to near 50°N, 33°W. The MANCHESTER ZEAL was sailing near 40.5°N, 42°W, and struggled with 60-kn winds. The LAURENTIAN FOREST had sailed out of one storm into another; this time the winds were 55 kn. The LEVERKUSEN had 50-kn winds. The GREAT REPUBLIC, about 300 mi directly south of the center, had mild 35-kn gales, but the seas were 15 ft, and the swells 30 ft. The AKADEMIK RYKACHYEV, within 1° latitude of the center, was battered for awhile by vicious cross-waves of 26 ft from 220°, and 33 ft from 120°. The EXFORDS' report at 1800 was winds--60 kn, and seas--30 ft. The next 6-hr synoptic report, at 42°N, 41.2°W, was only 50 kn, but the sea height had increased to 31 ft.

The storm's path was toward Kap Farvel, and the pressure was 948 mb, at 1200 on the 24th. The closest ship report was 50 kn, just off the western Iceland coast. High swells were the major factor to the south, where the closest report was about 600 mi from the center. As the center reached the southeast coast of Greenland, it deteriorated rapidly. This was assisted by a new LOW near 45°N.

This was the LOW that assisted in the demise of the one above. It developed in the Gulf of St. Lawrence, on the 23d, and moved southeastward and eastward around the circulation of the storm described above. Gales were reported around the storm, on the 24th and 25th. At 1800 of the 24th, the SEALAND RESOURCE, at 39.7°N, 34.7°W, logged in with 55-kn winds and 30-ft swells. At 1200 on the 25th, the 964-mb center was near 47°N, 31°W. A ship reported 33-ft swells about 200 mi south of the center. At this time, the storm became stationary. The ATLANTIC COGNAC, near 42°N, 32°W, was battered by 50-kn winds and 36-ft seas. A ship east of the center, near 46°N, 24°W, was sailing with 40-kn winds on her stern, 13-ft seas, and 33-ft swells.

As the cyclone continued to spin near 45°N, 30°W, at 1200 on the 26th, the ATLANTIC COGNAC turned toward the northwest, into the 65-kn maelstrom which was driving 49-ft seas. The C. V. STAGHOUND and EXPORT LEADER were farther to the west and southwest with only 40- and 50-kn winds, with swells to 25 ft. At 0000 on the 27th, Ocean Weather Station "K" reported 45-kn winds, but the seas were a keel-breaking 39 ft. Twelve hours later, the HEMIMACTRA, about 150 mi north of Kilo, reported 33-ft swells. On the southwest side of the storm, the SERAFIN TOPIC (36.1°N, 32.6°W) had 20-ft seas and 36-ft swells, with 45-kn winds.

The LOW was now moving toward the southeast, and the pressure had risen to 992 mb. At 1200 on the 28th, it could no longer be analyzed from the ship reports, but the effects were still being felt, at 1800, by the AMERICAN LEGACY, at 46°N, 37.5°W, with 55-kn winds and 41-ft swells.

Early on the 23d, light southerly winds prevailed over the Gulf of Mexico. Later in the day, a cold front swept southeastward off the coast. It was being pushed by cold northerly air out of the northern plains circulating around a 1043-mb HIGH over Idaho. The buoy EB-12 (26°N, 94°W) transmitted 40-kn winds from the north-northwest at 1200. At 0000 0n the 24th, two ships very near each other, the MARYLAND TRADER (27.6°N, 91.5°W) and the MOBIL VIGILANT (27°N, 91.5°W), both reported 45-kn gales, and 12- and 20-ft waves, respectively. EB-12 now measured 30-kn winds. At 1200, the EXXON WASHINGTON, near 26°N, 88°W, had 40-kn gales, with other reports of 30 to 40 kn in the southern Gulf. A separate HIGH had broken away from the main center and was moving across the lower Gulf, turning the winds westerly in the northern Gulf. The EXXON WASHINGTON was still reporting 40-kn gales as she approached the Louisiana coast on the 25th. By 1200, the HIGH was centered over the Gulf, and the winds had returned to normal speeds.

This storm had only a minor effect on coastal shipping, but could have been quite dangerous to any shipping on the Great Lakes. A few ships were still operating on the Lakes this month. The storm originated in Louisiana, on the 23d, and moved northward. Over the Ohio River, it curved northwestward for 12 hr before continuing northward through Wisconsin. Late on the 24th, a thunderstorm with 87-kn winds hit Olean, in western New York.

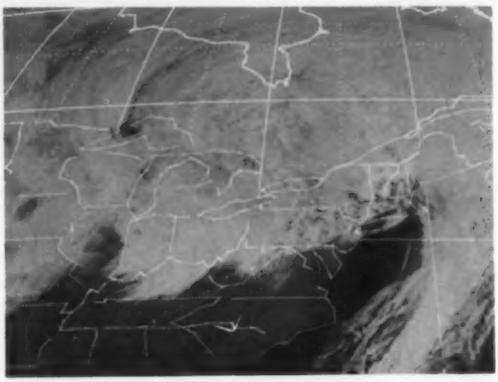

Figure 42.--This SMS image shows the immense cloud cover associated with this storm. At this time, the surface center was south of James Bay.

After the storm center crossed Lake Superior, gale warnings went up for the Lakes (fig. 42). On the 26th, the storm center was east of James Bay at 972 mb. Storm warnings were now up for the Lakes. Westerly winds with gusts over 50 kn were producing waves up to 14 ft high, and beach erosion and flooding were occurring on the eastern ends of Lakes Ontario and Erie. The Coast Guard Station at Erie, Pa., and also Rochester, N.Y., reported gusts over 50 kn. Waves of 6 to 12 ft were reported on the eastern shore of Lake Michigan. It was not until the 27th that the warnings were lowered. At this time, the storm's center was over the eastern shore of Hudson Bay and again turning westward, which meant its demise.

Ships on the Mediterranean Sea may have viewed the dense clouds of smoke, ashes, and sand from an eruption of Mt. Etna, on Sicily, which began on the night of the 23d and continued for several days.

Casualties--In the Gulf of Mexico, off Galveston Island, the 9,043-ton Finnish freighter MALTESHOLM (fig. 43) and the 19,724-ton Panamanian freighter MARITIME UNITY collided in dense fog on the 2d. The Canadian CHESLEY A. CROSBIE became immobilized in ice, on the 3d, after having engine problems. A sister ship towed her to Seven Islands, escorted by the icebreaker SIR JOHN A. MACDONALD. The Cypriot tanker ATHENIAN STAR (11,879 tons) sustained a crack in her hull in 40-ft seas, while on a voyage from Rotterdam to the United States.

The crew of the Greek tanker IOANNA (9,918 tons) was taken off the vessel due to taking water in heavy weather, while aground 20 mi off Rijeka, Yugoslavia. The barge HANNAH 2901 broke away from the tug JAMES A. HANNAH during high winds, at Milwaukee on the 23d.

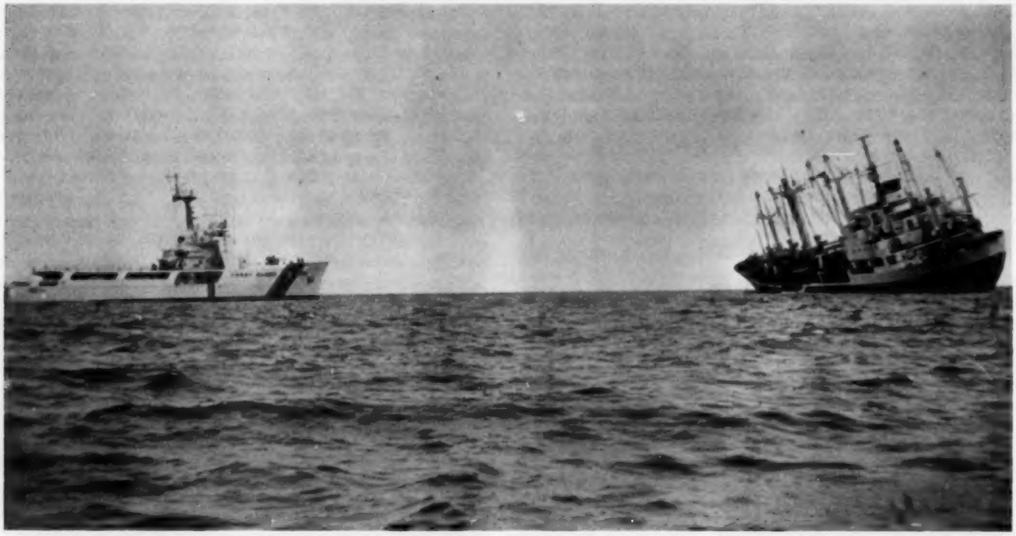

Figure 43.--The USCG Cutter VALIANT stands by the MALTESHOLM, in the Gulf of Mexico, after a collision with the MARITIME UNITY in fog. U.S. Coast Guard Photo.

Smooth Log, North Pacific Weather

January and February 1975

SMOOTH LOG, JANUARY 1975--There is some kind of a theory about everything evening out in time and space. It appears to work here, as the North Pacific was below normal in the number of cyclones this month, while the Atlantic was above normal. The tracks were also more diverse. The two major tracks were from Japan into the Bering Sea, and east of Japan into the Gulf of Alaska. The climatological tracks from the central Pacific north of Hawaii into the Gulf of Alaska and Vancouver Island were represented by only one or two storms.

The monthly mean pressure pattern was near the climatological mean in shape and center locations. A 1042-mb High dominated central Asia, the 1003-mb Aleutian Low was near 50°N, 170°E, with a 1004-mb companion Low over the Gulf of Alaska near 56°N, 145°W, and a 1028-mb High was near 34°N, 137°W. This was one of the few times in the last several years that the central pressure of the Aleutian Low was greater than the climatological mean--1003 mb versus 1000.4 mb.

The anomaly chart was all positive, north of latitude 20°N, except for a minus 5-mb center off Yakutat, Alaska. The largest positive center was 7 mb, near 37°N, 135°W.

The upper-air mean flow also closely paralleled climatology. The gradient was more intense than normal, notwithstanding that the height of the upper-air Low over the Sea of Okhotsk was above normal. This resulted because the pressure surface height over the middle and southern ocean was 100 to 200 ft above the normal mean. The mean windflow was northwesterly off the Asian mainland, turning westerly east and south of Japan, then west-southwesterly east of 180°, and again westerly over the West Coast.

Typhoon Lola was the only tropical cyclone this

month.

Extratropical Cyclones -- A small LOW was analyzed near 35°N, 154°E, at 1200 on the 1st, on the strength of two ship reports. Twenty-four hours later, it was located near 37°N, 166°E, again using data from only two ships. This indicates how valuable every ship report is that can be broadcast over the radio. At 0000 on the 3d, the LOW had intensified to 989 mb near 42°N, 179°E. The PEARL VENTURE, near 38°N, 170°E, was blasted by 45-kn gales, with 20-ft waves. The KINYO MARU was at 48.4°N, 167°W, at 1800, and measured 55-kn winds and 20-ft swells. By 0000 on the 4th, the 968-mb center was near 49.5°N, 162°W, and the VAN CONQUEROR was at 46.4°N, 162.8°W, with 60-kn storm winds on her bow. As the storm crossed the Gulf of Alaska on the 4th and 5th, the GOLDEN RAY and the ESSO NEWARK both reported 40-kn gales. The low center crossed the coast, late on the 5th, but the circulation remaining over the water continued and whipped the PHILADELPHIA with 48 kn, 12-ft seas, and 30-ft swells.

Can you believe a 1028-mb LOW? That is how this storm had its origin over eastern Mongolia, on the 3d. It was still only 1012 mb, on the 6th, near 31°N, 158°E, but after that it developed rapidly. Early on the 7th, gales were reported, and, at 1200, the MIDAS SEINE, near 34°N, 176°E, was about 210 mi southwest of the center with 65-kn westerly winds, but only 16-ft seas, on her northerly track.

At this time, another LOW was south of the Aleutians; this LOW passed south of it to be absorbed on the 8th. The HARFLEET (34°N, 173°W) and the THOMAS E. CUFFE (37°N, 169°W) reported 45-kn winds on both sides of the front, south of the southern LOW. The TOYOTA MARU No. 10 was about 120 mi south of the northern LOW, with 50-kn winds. At 1200, there was only the northern LOW remaining on the analysis.

At 0000 on the 9th, the 964-mb storm was headed northeastward south of the Aleutians. The SUMMIT was off the north shore of Unimak Island with 65-kn typhoon-force winds. About midway between the island and the LOW, the KASUGAI MARU battled 50-kn winds and 26-ft waves. Southeast of the center, the MYOKEN MARU also braved a 50-kn storm with 16-ft seas and 26-ft swells. Gales continued around the storm as it filled and moved into the Gulf of Alaska. The SUMMIT continued to be battered by high winds on the 10th--55 kn--near the same position. On the 11th, this LOW combined circulations with a LOW moving northward in the Gulf.

This third LOW had originated near 43°N, 147°W. At 0000 on the 11th, the TOYOTA MARU No. 10 had driven into 40-kn gales near 34°N, 147°W. The WORLD PELAGIC (54.2°N, 139.6°W) had her own problems with 44-kn winds, 220-yd visibility, 17-ft seas, and 36-ft swells. By 0000 on the 12th, this LOW was 950 mb at 55°N, 143°W. The HOTAKA MARU was about 60 mi south of the center, with 50-kn winds, the same as the NANSHO MARU experienced about 180 mi southwest of the center. In this area, the waves were running about 16 ft. It was different for the WORLD PELAGIC, about 140 mi east of the center. She had only 48-kn gales, but the seas were 21 ft and the swells 39 ft. The CORAL ARACADIA (52.4°N, 138.9°W) measured 60-kn winds.

Later on the 12th, the KOREAN MAIL was headed toward the Alaska Peninsula into a 55-kn storm with 33-ft seas. Other ships, including PAPA, were reporting high gales. On the 13th, the LOW reversed directions and headed westward. The weather hadn't improved for the NANSHO MARU, and she wasn't speeding westward, as the 0000 report was 55 kn. Far to the north, just off Yakutat, the ALASKA STANDARD was headed into 50-kn winds. The buoys EB-03 and EB-33 appeared to be reporting reliably. EB-03 reported 26-ft seas. To the south, PAPA was radioing 45-kn gales with 30-ft seas. The SUMMIT was south of Seward and tossed by 60-kn winds. The storm could not survive a westward track for long and was deteriorating. By 1200 on the 14th, the pressure had risen to 1006 mb, but the WASHINGTON MAIL still managed to find 50-kn winds. Twelve hours later, the LOW was gone.

A LOW was centered over Terpeniya Gulf, and, on the 11th, a minor trough developed off the south coast of Japan. As it moved eastward, a 988-mb LOW formed, near 35°N, 150°E, at 1200 on the 12th. The PRESIDENT FILLMORE was southwest of the center (28.6°N, 145.5°E). The winds were estimated at only 45 kn, but the seas were 33 ft. Not far away, the ALMIZAR (28.2°N, 149.8°E) estimated 50-kn winds and 26-ft seas.

At 0000 on the 14th, the 964-mb LOW was near 45°N, 173°E. The MARUSUMI MARU, about 150 mi southeast of the center, had 50-kn winds and 20-ft waves. Twenty-four hours later, the swells had increased to 26 ft. On the 16th, the LOW's cyclonic circulation covered a large portion of the ocean north of 25°N--about 3,000 mi in an east-west direction and 2,000 mi north-south. High seas were more significant than high winds, although the LEO, at 36.5°N, 174.7°E, measured 55 kn and 20-ft seas. The SHOZUI MARU (41.5°N, 172°E) wallowed in 31-ft quartering swells. Several other ships reported 25-ft swells in the southwest quadrant. As far south as 33°N, 178°E, the SCHOUWEN had 45-kn winds, 10-ft seas, and 28-ft swells. At 1200, the TOWER BRIDGE encountered 30-ft swells, near 41.5°N, 173°E.

On the 17th, the center was about 100 mi south of Dutch Harbor, but was influencing ships far to the southwest. The PRAG found 45-kn winds and 26-ft waves at 32°N, 179°E. The PRESIDENTS were having rough voyages: the POLK, at 30°N, 175°E, was battered by 34-ft swells off her starboard bow, and the VAN BUREN, at 35.5°N, 152.7°E, was pounded by 33-ft waves and 50-kn winds.

On the 18th, the surface center performed a cyclonic loop under the influence of the upper-air LOW. Another center formed in the eastern area of the circulation and raced into the Gulf of Alaska as a new primary storm. On the 19th, the AVILA logged 50-kn winds, 18-ft seas, and 25-ft swells with that center.

The East China Sea contributed this storm to the coastal seamen and fishermen of the western Pacific. It moved over Japan bringing rain to the lower elevations and snow to Korea. By 1200 on the 22d, the pressure had dropped to 989 mb northeast of Tokyo. At this time, it was snowing over northern Honshu. South of the center, near 30.5°N, 142.5°E, the aptly named

NIPPON MARU was headed for Tokyo Bay with 40 kn on her stern. At 0000 on the 23d, the OJI was only 60 mi southwest of the 972-mb center, with howling 65-kn northwesterlies. Winds of 45 kn were blowing to the south and northeast of the center. The PRESIDENT MONROE (35.6°N, 153.9°E) had 47-kn winds and 25-ft seas. Gales continued all around the storm as it moved eastward along the Kuril Trench. Waves up to 23 ft were reported. On the 23d and 24th, several ships measured windspeeds between 50 and 60 kn. They were the ASIAN BRAVERY, CHALMETTE, and POLAR ALASKA. The storm continued deepening to 956 mb as it crossed the Bering Sea. The pressure gradient indicated that winds stronger than gales could have been present, but they were not broadcast.

The center crossed into eastern Siberia, on the 26th, then turned sharply eastward to pass over the Bering Strait and disappear into the frozen Chukchi Sea.

A LOW formed in an area of weak pressure gradient, off the east coast of Japan, on the 27th. Nothing much occurred in the first 12 hr, but by 24 hr, a well-developed storm was raging. The SURUGA MARU at 40.5°N, 156°E, and the RYOKKO MARU at 39.5°N, 150°E, had 45- and 40-kn winds on opposite sides of the center. This storm was also headed toward the Bering Sea. Again only gale-force winds were reported, until 1200 on the 29th, when the 956-mb center was near 51°N, 164°E. The SHOYO MARU broke the pattern with a 55-kn report from 51°N, 159°E. A ship north of the center reported 26-ft seas. The MIDAS ARROW, south and east of the center, fought 20-ft seas and 33-ft swells.

As the LOW passed northward west of Ostrov Beringa, that island was ravaged by 70-kn winds from the south. The temperature was 0°C. The map 12 hr later still indicated 70-kn winds, with 55-kn winds reported over the Kurils, and the highest reported by ships. The storm was dying as it moved across Siberia into the East Siberian Sea, on the 31st, but the PHILIPPINE MAIL (47.1°N, 165.6°E) had 50-kn winds, 20-ft seas, and smashing 41-ft swells. The HONSHU MARU, less than 100 mi away (48.2°N, 166.5°E), measured 55 kn, but seas and swells of 20 and 25 ft.

Tropical Cyclones, Western Pacific--Lola developed near Palau Island, on the 22d. She moved westward toward Mindanao. Late the following day, she reached typhoon intensity near 9°N, 130°E. Winds near her center reached 70 kn, and gales extended out 200 to 300 mi before Lola crashed into northern Mindanao, on the 24th. She quickly lost typhoon strength and turned toward the west-northwest. By the 25th, Lola was into the South China Sea. Her maximum sustained winds remained at 40 to 50 kn for the next several days. During this period, the 4,031-ton Panamanian-registered freighter GULF BANKER sank 170 mi west of Manila. All 31 crewmembers were rescued by the U.S. Navy escort ship MEYERKORD. The storm finally fizzled out on the 28th before reaching land.

Winds and a storm tide were destructive in the Philippines. Lola left more than 15,000 people homeless, and an estimated 31 dead. Most of this death and destruction occurred in the clusters of islands in the Visayas. The storm tide struck the eastern shores of Tandag.

Casualties--The 7,274-ton ore carrier LAKE ILLAWARRA struck the Tasman Bridge, which crosses the Derwent River, and a 240-ft section fell into the river. The ship sank, 2 crewmen were lost, and up to 12 persons were in automobiles that fell into the river. The 11,025-ton Liberian WILSHIRE BOULEVARD reported heavy-weather bow damage on arrival at Shinaizu. The American tug DAVID FOSS sank in Cook Inlet, on the 11th. The vessel suddenly began filling with water, and the crew abandoned ship in adverse weather. The crew was picked up by helicopter. The 10,000-ton Liberian tanker FLORENCE and the 1,526-ton Greek freighter MINIMABOR collided in a storm off southern Japan, on the 12th. Both continued on their way.

The 27,506-ton tanker BRITISH AMBASSADOR sank, on the 13th, while being towed by the tug ARCTIC. The Indian-registered MARATHA PROVIDENCE (22,593 tons) sustained heavy-weather damage on a voyage from the U.S. west coast to Singapore. The 945-ton Japanese freighter GOYO MARU No. 21 sank in heavy seas off western Japan, on the 18th. Seven crewmen were found dead, and five are missing. The Liberian oil tanker NORFOLK (20,915 tons) struck the Benicia-Martinez bridge at Martinez, Calif., in dense predawn fog, on the 22d. The Panamanian GULF BANKER (4,031 tons) sprang a leak in heavy weather and sank 170 mi west of Manila on the 28th. The crew was rescued.

The 3,419-ton Korean POONG NION went aground at 26.6°N, 127.5°E, on the 16th, in poor visibility.

SMOOTH LOG, FEBRUARY 1975--This was probably as normal a month, when compared to the climatological mean, as is possible. The storm tracks followed the mean paths from Hokkaido and south of Kyushu toward the Rat Islands, from there south of the Aleutians into the Gulf of Alaska, almost as if they had been traced. The same applied to the tracks from the northeast central ocean into the Gulf of Alaska and Vancouver Island.

The 1000-mb Aleutian Low was almost identically located with its 1000.3-mb climatological counterpart. The most significant difference from climatology was an extension of lower pressure into the Gulf of Alaska. The 1004-mb isobar extended to near 140°W in the Gulf of Alaska, which is normally the boundary of the 1012-mb isobar. The 1016-mb isobar normally paralleled the Coast Mountains of British Columbia, with a resultant tight pressure gradient along that coast. The 1021-mb Pacific High was about 400 mi east of its 1020.8-mb climatic location. The pressure of the ridge that extends across the ocean along approximately 25°N was generally higher than normal.

The anomalies were not large. The largest both in area and depth was a negative 8-mb centered over the Gulf of Alaska and northeastern ocean. There was a negative 2-mb center over the western Sea of Okhotsk that was completely surrounded by positive values. This was the reflection of three storms that curved northwestward into the area. There was a positive 4-mb area in the central ocean near 30°N, 175°W, and a positive 3-mb area off Baja California.

The upper-air pattern was near normal with a couple of exceptions. A minor Low at 700 mb over Cape Romanzof reflected the lower sea-level pressure over the Gulf of Alaska. It also induced a short-wave trough

off the North American coast, accenting the ridge over the Rocky Mountains. The height of the 700-mb surface over the tropical ocean was higher than the mean, resulting in an overall tighter gradient.

There were no tropical cyclones this month.

Extratropical Cyclones--Small frontal waves had been occurring for several days along an east-west front over the East China Sea. On the 4th, one of these was unstable and continued to develop while south of Honshu, bringing precipitation to most of Japan. The CLARA MAERSK was just outside Tokyo Bay with 45-kn gales. At 0600 on the 5th, she recorded 48-kn winds and 28-ft seas. As it moved over the Kuroshio Current, the storm continued to deepen to 976 mb, at 1200 on the 5th. The TOR FOREST was slightly south of the cold front, at 32°N, 156°E, with 50-kn southerly winds. Another unidentified ship reported 50-kn northwesterly winds at 35°N, 147°E. The BREWSTER took a special observation at 1700, when she measured 60-kn winds, at 33.4°N, 160.3°E. At 0000 on the 6th, the EASTERN MARINER, near 33°N, 157°E, was blasted by 60-kn winds off her starboard bow, and driving 25-ft swells. The ORIENTAL DESTINY (30.7°N, 160.8°E) was hit by 23-ft seas and 33-ft swells, with 50-kn winds. Other ships were reporting 20- to 30-ft waves. The SANSHIN TRADER was near the point of occlusion, at 36°N, 166°E, with 45-kn southeasterly winds, 21-ft confused seas, and 25-ft swells from the south. At 1200 on the 6th, the UHUE also reported 60-kn winds from the northwest with heavy snow, near 38°N, 162°E.

The storm was now tracking northward with a central pressure of 965 mb. At 0000 on the 7th, the MARQUIS, at 34°N, 171°E, radioed 45-kn winds, but she was being battered by 25-ft seas and 33-ft swells, 30° off the seas. As the storm approached the Rat Islands on the 8th, it was weakening and was absorbed by another LOW approaching from the southwest on the 9th.

A front stretched southward, approximating 160°W, from a LOW in the Bering Sea. Waves were moving northward along the front. On the 5th, one of these persevered and took an easterly track. The 986-mb center was near 38°N, 142°W, and the IDAHO was near 32°N, 149°W, with 40-kn winds and 16-ft seas. On the 6th, the storm was tracking northward and turning toward the west. The CHEVRON HAWAII was at 49.6°N, 138.3°W, with 53-kn easterly winds and 35-ft seas. At 0000 on the 7th, the ARCO SAG RIVER (51°N, 139°W) reported 50-kn winds, 25-ft seas, and 30-ft swells. At 1200, the CHEVRON HAWAII was east of the 986-mb center, measuring 47-kn winds with giant 28-ft seas and 38-ft swells. Early on the 8th, the HARFLEET had 30-ft seas northwest of the LOW. During this period, several minor LOWs had developed around the primary system, and, on the 9th, one of these became the primary storm and moved onto the U.S. west coast.

This frontal wave was first indicated on the 0000 analysis of the 11th, by the reports from three widely separated ships. By 1200, it was a 998-mb LOW, but the circulation was not well organized. Twenty-four hours later, it was a well-organized 979-mb storm, near 48°N, 175°E. The ALASKA MARU reported 40-kn easterly winds in the northeast quadrant. Far to the east, the NOAA ship OCEANOGRAPHER measured 48-kn winds and 32.5-ft seas. The storm was moving northward into the Bering Sea. At 1800, the POLAR ALASKA, at 53.5°N, 173.6°E, measured hurricane-force 72-kn winds from the east. The PAPYRUS MARU found 40-kn gales and 23-ft seas near 50°N, 179°E.

At 1200 on the 13th, the JUNEAU MARU, near 51°N, 170°E, was pounded by 60-kn westerly winds. The Near Islands measured 50-kn west-southwesterly winds. The LOW had decreased in size, but not intensity, as it crossed into the Bering Sea. This was partially due to another storm to the south. On the 14th, the circulation was completely absorbed.

This storm had its beginnings, on the 12th, in a trough just off the eastern shore of northern Japan. This was also a case where the LOW developed first and then frontogenesis occurred. In the next 24 hr, the LOW traveled to 43°N, 159°E, and dropped 28 mb to a 978-mb pressure. The HIEI MARU was near 38°N, 165°E, just north of the occlusion, with 45-kn winds. Twelve hours later, at 0000 on the 14th, the AKAISHI MARU was about 100 mi southwest of the center with 60-kn winds and 23-ft swells on her stern. At 1200, the winds were still 50 kn, and the 15-ft seas and 23-ft swells still persisted. The LOW was now stalled near 48°N, 168°E, and, at 0000 on the 15th, the CHINA BEAR found the 50-kn wind band and 16-ft seas, with 23-ft swells. Forty- and 45-kn easterly winds were blowing north of the center.

The loss of forward motion was fatal to the system, as LOWs to the southeast and southwest robbed it of its strength.

This was one of the LOWs that contributed to the death of the last one. While the previous storm was at its maximum strength, this new one was starting out over the East China Sea. As the storm moved south of Japan, it gained strength, and gale-force winds were reported in the southwest quarter. The ROBERTS BANK, at 27.1°N, 139.1°E in the southeast quadrant, had 56-kn winds and 15-ft seas. The CHINA BEAR had 20-ft seas and 25-ft swells northeast of the center, at 0600 of the 15th. At 1200, the 958-mb LOW was at 38°N, 157°E. The FRISKAY was near 33°N, 157.5°E, with 55-kn southwesterly winds, 20-ft seas, and 30-ft swells. The TOYAMA was west of the center with 50 kn. The JAPAN BEAR was about 100 mi east of the center with 45-kn gales and reported 26-ft seas, with 23-ft swells. At 0000 on the 16th, the PACKING radioed 60-kn storm winds and 23-ft seas, at 40°N, 161°E. The weather hadn't improved for the JAPAN BEAR, who now measured 55-kn winds and 30-ft seas and swells.

At 1200, the storm was a 952-mb whirlpool, and shipping was giving it a wide berth, or so the ship reports indicated. The HONSHU MARU was near 49°N, 178°W, with 30-ft swells, and the PHEMIUS, on the opposite side of the LOW, reported 25-ft seas and swells.

This system, along with a HIGH off the California coast, was now the primary circulation over the northern ocean. Two small LOWs flanked this primary one. At 0000 on the 17th, the ASIA MOMO was near 51°N, 165°E, in the northwest quadrant of the LOW, sailing with 55-kn winds and 20-ft waves. A ship south of the LOW, near 42°N, 177°W, was boosted along by 50-kn winds, while the ASIA BRIGHTNESS, near 42°N, 173°W, was plowing into 45-kn gales, 20-ft seas, and 25-ft

swells. At 1200, there were no ships plotted south of the center within 700 mi of the LOW.

The cyclone had continued its eastward track while slowly filling, and the flanking LOW to the east had dawdled into the Gulf of Alaska. On the 18th, that system took over the circulation and moved into the Yukon.

There were several centers of circulation across the northern ocean on the 19th. One in midocean developed into a major storm. At 1200, it was 988 mb, near 44°N, 179°W. Early on the 20th, the SHINYO MARU (41.5°N, 179°W) had 45-kn westerlies, 20-ft seas, and 24-ft swells.

The LOW was moving rapidly toward the Gulf of Alaska, deepening, and expanding its circulation as it went. At 0000 on the 21st, the 961-mb LOW was at 52.5°N, 158°W. The HILLYER BROWN, east of the center, had 40-kn winds. At 1200, the LOW was at its lowest pressure--954 mb--just south of Kodiak Island. The OCEANOGRAPHER was at 59.8°N, 145.3°W, and measured fantastic 68-kn winds and 35-ft seas. About the only research that can be done in that type of weather is how to survive.

At 0000 on the 22d, the J. L. HANNA was near Sitka with 55-kn winds, 12-ft seas, and 25-ft swells. Many ships were reporting gales as far south as 30°N, and west to 180°. Later, the LOW moved inland over the Kenai Peninsula and was lost in the interior.

This cyclone was born near Nagoya, late on the 20th. It matured to gale strength quickly, as the MITSUI MARU found 40-kn gales, with 20-ft waves, at 31°N, 137°E. Rain, snow, and thundershowers were occurring over the Japanese Islands. At 1200 on the 21st, the YASUKAWA MARU was 2° longitude to the east, with 50-kn winds, 10-ft seas, and giant 33-ft swells. The strong-wind band was between 30° and 35°N. Another LOW which was preceding this one was helping to build the seas and swells.

The 7,857-ton Japanese ferry SHIRETOKO MARU departed Tokyo, on the 20th, for Hokkaido. On the 21st, it had to divert seaward into the high waves to avoid capsizing. Contact with the ferry was lost when its course took it out of range of its radiotelephone. Radio contact was reestablished on the 22d, and it arrived at Tomakomai on the 23d. There were 156 people and 129 automobiles aboard. Three trucks, carried as cargo, shifted position. Late on the 21st, the Philippine freighter DONA PACITA ran aground and snapped her hull, off Onagawa Port, northern Honshu. The freighter had taken refuge at the port from rough seas and took a wrong course when leaving. Twenty-seven of the 38 crewmembers either swam to safety or were rescued by helicopter.

At 1200 on the 22d, the 984-mb LOW was at 37.5°N, 152°E. The COSMOS FOMALHAUT, HOHKOKUSAN MARU, and KUROBE MARU reported 40- to 50-kn winds, 16- to 23-ft seas, and all 26-ft swells. Twelve hours later, the SEA-LAND COMMERCE, at 33°N, 154°E, was headed into 55-kn winds and 20-ft waves, while the TOYOTA MARU No. 10 was returning to home port into 50-kn winds, 25-ft seas, and 33-ft swells. At 1200 on the 23d, the HISASHIMA MARU found the 50-kn winds and 30-ft seas about 5° farther east. By the next map, the LOW was no longer indicated by the data as having existed.

A severe earthquake, centered at 53.3°N, 173.4°E, shook the Near Islands at 0725 February 2. Large cracks, up to 16 in wide and 100 ft long, occurred on Attu Island. There was no tsunami, due to the epicenter being north of the Aleutians.

Casualties--The 1,997-ton RIO TRADER sank at Amami Shima, north of Okinawa, in heavy weather, on the 11th, after developing a leak. The 3,799-ton KHORFAKAN broke moorings in heavy weather, on the 12th, and ran aground at Sharjah, in the Persian Gulf, with a cargo of cement.

The Indian freighter CHENNAI MUYARCHI sustained heavy-weather damage and flooding of Hold No. 1 on a voyage from the Columbia River to Bombay, the first part of the month. The TRANSOCEAN SHIPPER, a 9,375-ton Philippine freighter, last reported passing through a storm, on the 16th, and that she had a damaged hatch cover. She was posted as missing when she failed to arrive at New Westminster, B.C., on the 25th.

The Liberian NORDIC REGENT arrived Chiba from Vancouver, on the 25th, with hatch covers leaking due to heavy weather. Winds up to 52 kn in the Vancouver area forced two anchored freighters aground in English Bay. Both were refloated with the aid of tugs. They were the 10,071-ton EVGENIA G., which broke its anchor chains, and the 10,508-ton PANAYIA MOUTSAINA.

A barge (fig. 44) loaded with oil went aground on Whidley Island, in Puget Sound, during heavy weather.

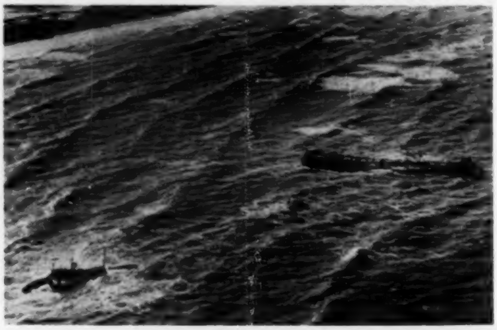

Figure 44.--The tug RELIEF and a barge loaded with 1 million barrels of oil are both aground about 150 yd from the beach of Whidley Island, in Puget Sound, on the 20th. Wide World Photo.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

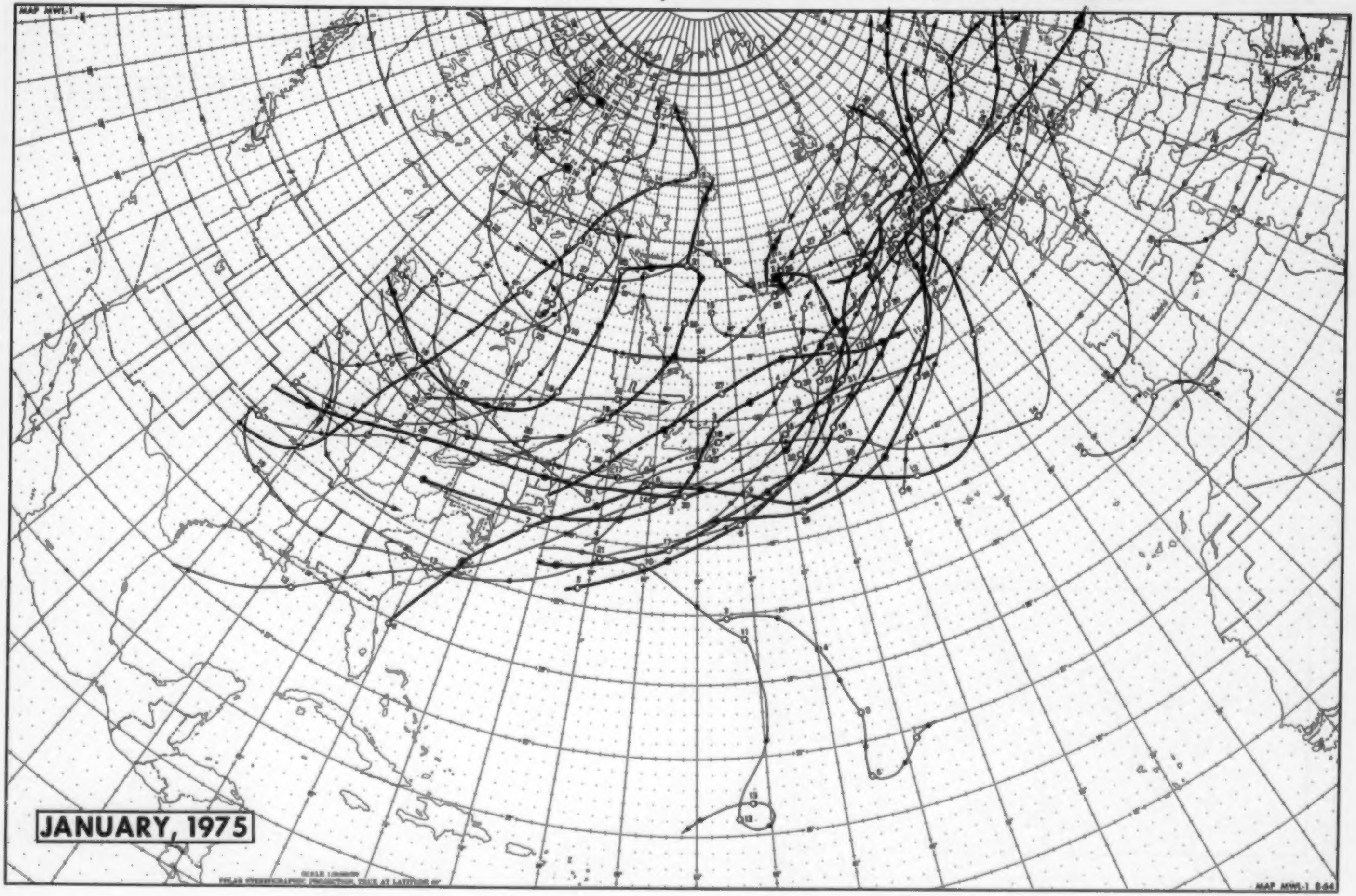

Figure 45. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

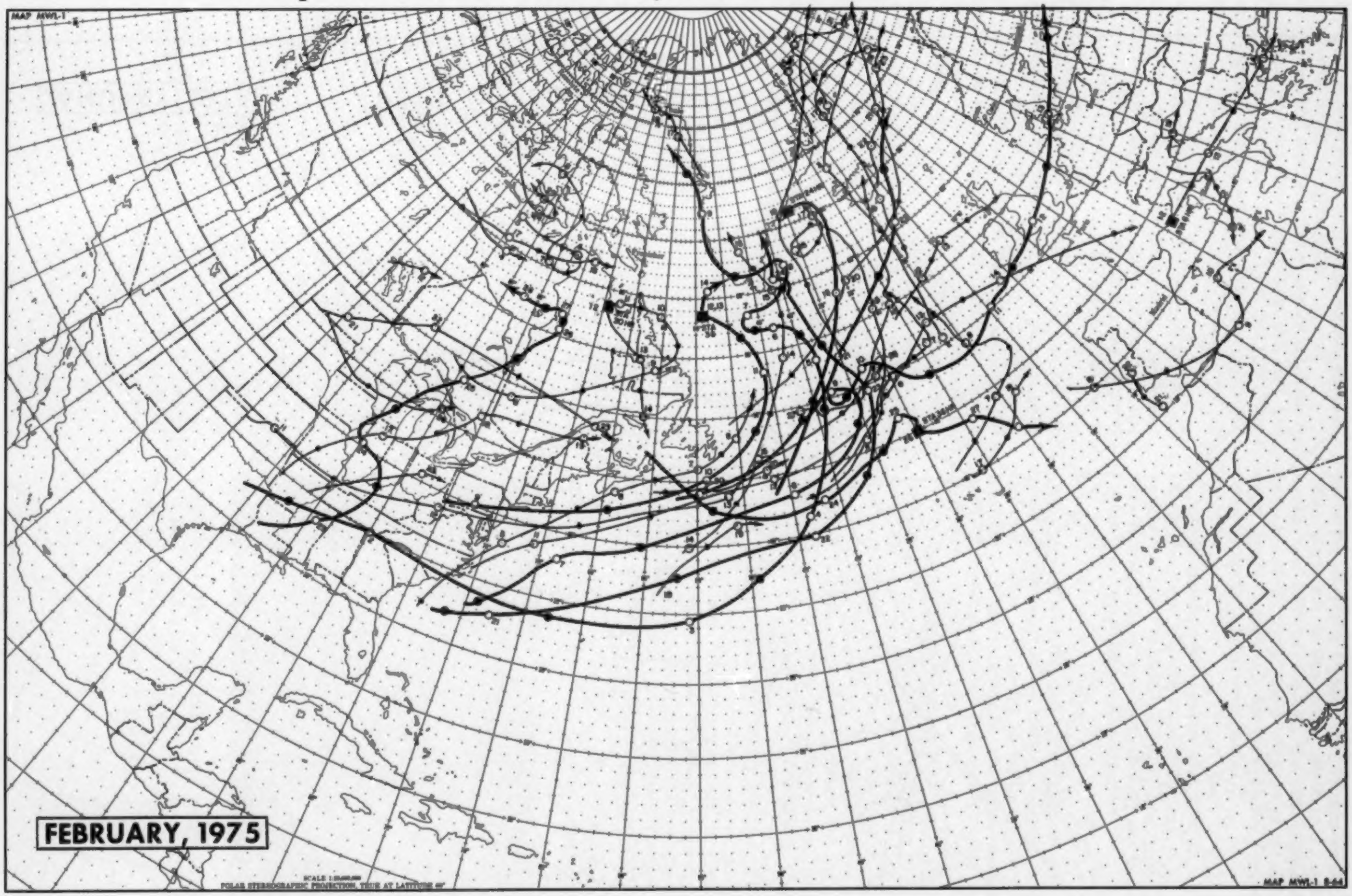

Figure 46. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

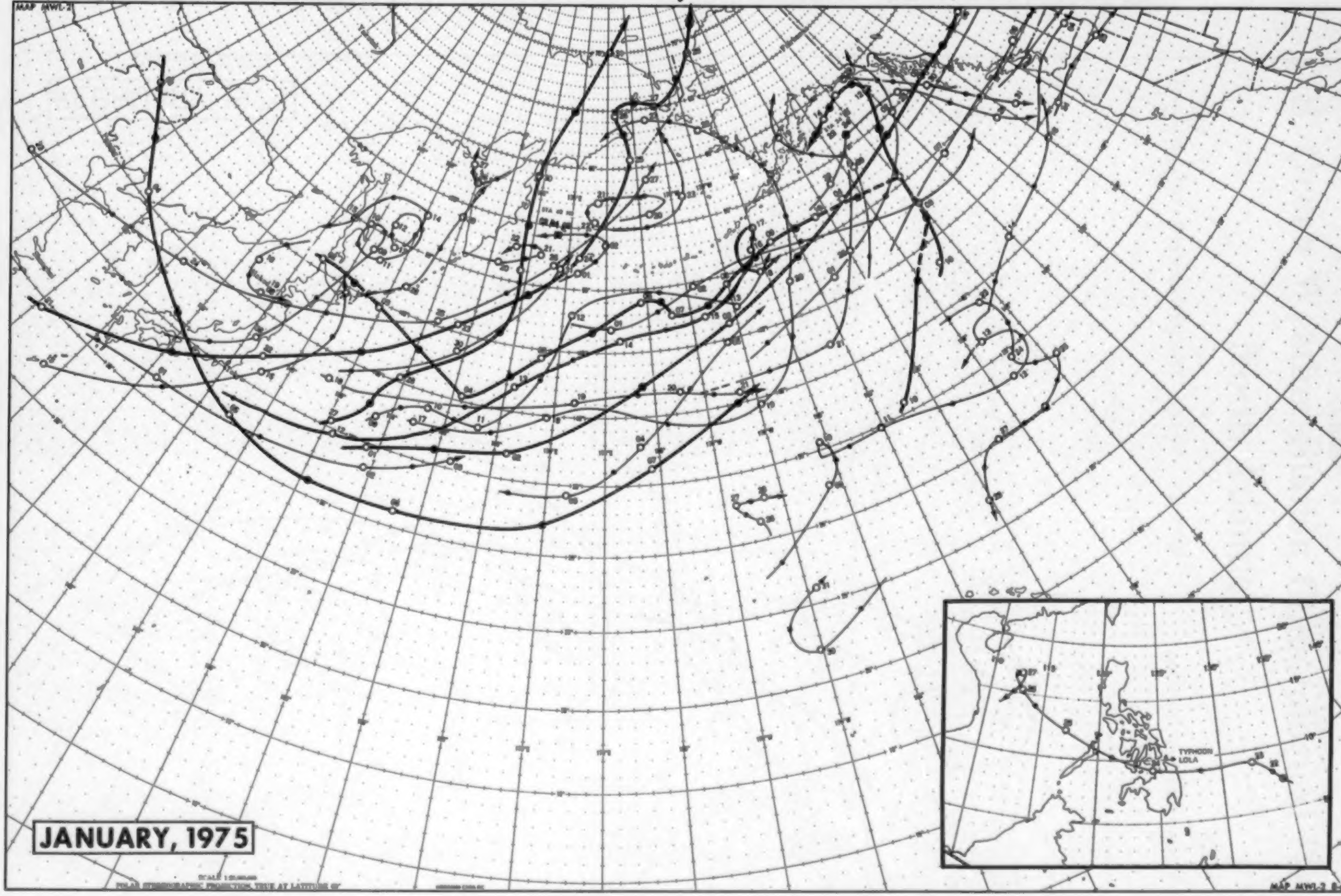

Figure 47. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

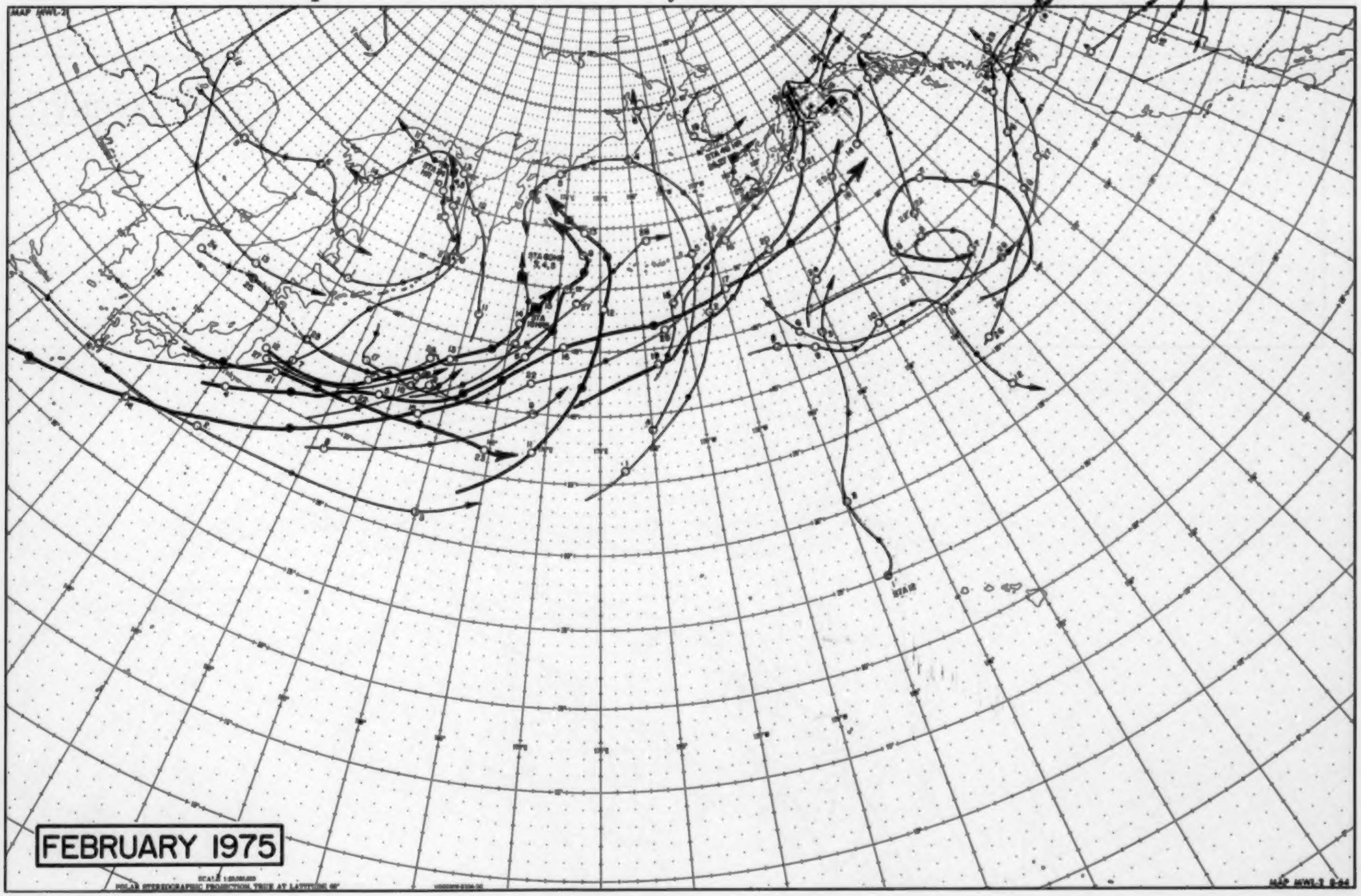

Figure 48. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Table 6
U.S. Ocean Weather Station Climatological Data, North Atlantic

Ocean Weather Station 'HOTEL' 38°00'N 71°00'W — **January and February, 1975**

MEANS AND EXTREMES

	DRY BULB TEMP (°C)					DEW-POINT TEMP (°C)					SEA TEMP (°C)					AIR-SEA TEMP DIFFERENCE (°C)				
MONTH	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR
JAN	1.9	19 06	11.1	18.1	23 21	-5.8	18 06	4.3	17.1	26 00	12.4	16 21	14.9	20.6	*26 12	-11.7	19 06	-3.7	3.7	29 18
FEB	2.8	14 06	10.2	17.9	*23 06	-3.9	14 03	5.3	16.3	24 18	12.2	14 18	15.7	23.3	20 06	-16.7	10 21	-5.5	2.8	23 00

	MEANS AND EXTREMES PRESSURE (MB)					PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) TOTAL CLOUD				LOW CLOUD				DAYS WITH SPECIFIED WEATHER										
MONTH	MIN	DA HR	MEAN	MAX	DA HR	0-2	3-5	6-7	8 & OBSC	0-2	3-5	6-7	8 & OBSC	PCPN	RAIN OR DRZL	SNOW	TSTM	VSBY <1NM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
JAN	993.3	26 00	1018.8	1036.8	10 03	5.2	10.9	32.7	51.2	21.8	29.8	33.9	14.5	22	22	3	3	0	15	5	1	31	18.1	248
FEB	993.3	12 21	1017.7	1037.1	04 15	15.7	13.0	23.3	48.0	31.8	33.2	23.8	11.2	21	21	0	0	1	7	4	0	28	18.2	224

** VV-90-93 AND/OR W=4 COMP OB DAYS=COMPLETE OB DAYS

Wind

JAN WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	4.3	7.9	2.1	2.0	.0	16.3	17.7
NE	.0	3.4	2.0	1.2	1.6	.0	8.3	18.3
E	.0	3.8	2.7	.0	.0	.0	6.6	10.1
SE	.0	.9	2.7	2.1	.1	.0	5.8	18.4
S	.0	1.2	2.6	3.3	1.5	.4	9.1	24.7
SW	.4	1.6	3.1	3.5	.1	.0	8.8	18.1
W	.7	2.0	5.3	9.6	3.3	.4	21.4	24.2
NW	.3	2.6	5.4	9.2	2.6	1.2	21.6	23.7
CALM	2.0	.0	.0	.0	.0	.0	2.0	.0
TOTAL	3.6	20.2	31.9	31.0	11.3	2.0	100.0	20.3

NUMBER OF OBS 248; MAX WIND: DIR 330, SPEED 65, DA HR 02 1048; VECTOR SPEED 8.5; MEAN DIR 296 (DIR IN DEGREES)

FEB WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	2.5	7.7	2.0	.7	.0	12.8	17.3
NE	.0	1.3	9.3	1.8	.0	.0	12.4	15.5
E	.0	.0	1.0	.9	.0	.0	1.9	15.9
SE	.0	.0	.4	.9	.4	.0	2.3	21.7
S	.9	1.1	3.7	1.2	.3	.0	7.2	14.9
SW	.0	3.3	6.7	1.5	1.5	.4	13.4	18.4
W	.4	3.2	8.3	10.4	.4	.0	22.8	20.0
NW	.4	3.1	12.9	6.5	2.3	.0	25.3	19.7
CALM	1.8	.0	.0	.0	.0	.0	1.8	.0
TOTAL	3.6	13.2	49.6	23.4	5.8	.4	100.0	18.1

NUMBER OF OBS 224; MAX WIND: DIR 240, SPEED 55, DA HR 12 2229; VECTOR SPEED 9.1; MEAN DIR 296 (DIR IN DEGREES)

Wave

JAN WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	5.3	4.6	1.2	4.0	1.0	.0	.0	16.2
NE	.0	2.6	2.3	3.2	3.3	.0	.0	.0	11.3
E	.0	1.4	.6	.8	.0	.0	.0	.0	2.9
SE	.0	2.2	1.7	.7	.0	.0	.0	.0	4.6
S	.0	1.7	3.4	1.7	3.7	.8	.0	.0	13.4
SW	.0	1.3	3.1	4.9	1.2	.0	.0	.0	12.6
W	.0	.0	6.0	3.3	2.9	1.4	.8	.0	14.7
NW	.0	1.1	4.3	2.8	7.3	.8	.0	.0	16.8
IND	.0	4.8	2.4	.0	.0	.0	.0	.0	7.3
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.0	20.6	32.7	19.0	23.0	4.0	.8	.0	100.0

NUMBER OF OBS 248 IND=INDETERMINATE

FEB WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	1.7	8.3	2.6	.7	.0	.0	.0	13.2
NE	.0	7.4	4.0	.0	.0	.0	.0	.0	11.4
E	.0	.3	1.7	.0	.0	.0	.0	.0	2.0
SE	.0	.4	.4	1.8	.9	.0	.0	.0	3.6
S	.0	1.2	2.8	2.8	.0	.0	.0	.0	7.9
SW	.4	4.2	3.0	1.8	1.6	.0	.0	.0	11.0
W	.4	4.2	4.3	4.1	3.7	.0	.0	.0	17.0
NW	.4	9.9	11.4	3.0	3.9	.0	.0	.0	28.7
IND	.0	4.0	.4	.4	.0	.0	.0	.0	4.9
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	2.2	33.3	37.1	16.3	10.7	.0	.0	.0	100.0

NUMBER OF OBS 224 IND=INDETERMINATE

JAN WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.0	3.2	7.7	1.6	.0	.0	.0	.0	12.5
6-7	.0	8.6	10.9	8.5	8.1	.0	.0	.0	35.1
8-9	.0	6.9	11.7	7.7	10.1	1.6	.0	.0	37.9
10-11	.0	.0	.0	1.2	4.8	2.4	.8	.0	9.3
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	4.8	2.4	.0	.0	.0	.0	.0	7.3
TOTAL	.0	20.6	32.7	19.0	23.0	4.0	.8	.0	100.0

NUMBER OF OBS 248; MAX WAVE HEIGHT: HGT 6.5, PER 11, DIR 270, TYPE SEA, DA HR 28 15; IND=INDETERMINATE (DIR IN DEGREES)

FEB WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	2.2	17.0	8.3	.0	.0	.0	.0	.0	27.7
6-7	.0	10.3	18.3	5.8	4.9	.0	.0	.0	39.3
8-9	.0	2.2	9.8	10.3	5.8	.0	.0	.0	28.1
10-11	.0	.0	.0	.0	.0	.0	.0	.0	.0
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	4.0	.4	.4	.0	.0	.0	.0	4.9
TOTAL	2.2	33.3	37.1	16.3	10.7	.0	.0	.0	100.0

NUMBER OF OBS 224; MAX WAVE HEIGHT: HGT 5.5, PER 8, DIR 340, TYPE SEA, DA HR 23 21; IND=INDETERMINATE (DIR IN DEGREES)

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

Table 7
U.S. Ocean Buoy Climatological Data
January and February 1975

JANUARY — DATA SUMMARY — EB01
AVERAGE LATITUDE 38.5N — AVERAGE LONGITUDE 077.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	02.4	(19 12)	14.1	22.6	(13 03)	247	31
DEWPOINT TEMP (DEG C)	-09.6	(19 12)	09.3	21.7	(12 03)	247	31
SEA TEMP (DEG C)	16.9	(13 21)	22.3	26.1	(25 00)	246	31
AIR-SEA TEMP (DEG C)	-18.3	(18 00)	-08.3	03.0	(13 12)	246	31
PRESSURE (MBAR)	0990.6	(25 21)	1020.1	1037.0	(18 03)	247	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 247

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		3.2	9.7	3.2			16.2	18.2
NE		3.2	.8	.8			4.9	10.8
E	.4	2.4	.8				3.6	8.4
SE		2.8	2.0				4.9	11.5
S		.8	3.2	4.5			8.5	20.7
SW		.8	4.5	8.9			14.2	22.4
W	.4	3.6	8.5	12.6	.8		25.9	20.5
NW	.4	2.0	12.1	6.5	.4		21.9	18.6
CALM								
TOTAL	1.6	19.0	41.3	36.8	1.2		100.0	18.1

MAX WIND
SPEED: 33 KNOTS
DIRECTION: 270 DEG
DAY: 26
HOUR: 12

PRECIPITATION
NO. OF DAYS WITH PRECIP: 21 NO. OF DAYS WITH REPORTS/ COMPLETE: 30 PARTIAL: 1
NO. OF OBS WITH PAST OR PRESENT PRECIP: 42 NO. OF WEATHER OBS: 247

JANUARY — DATA SUMMARY — EB03
AVERAGE LATITUDE 36.0N — AVERAGE LONGITUDE 147.9W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-02.0	(07 06)	00.4	06.7	(18 18)	242	31
DEWPOINT TEMP (DEG C)	-10.0	(06 09)	-01.9	04.2	(22 18)	242	31
PRESSURE (MBAR)	0973.1	(12 03)	1005.0	1037.6	(28 06)	241	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 239

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.3	6.3	7.9	4.6			20.1	13.9
NE	1.3	6.3	1.7				9.2	9.7
E	.8	8.8	7.1	3.5			17.2	13.2
SE	1.3	4.2	5.4				10.9	10.2
S	.4	6.7	.8				7.9	8.8
SW		3.3	.8				3.3	8.4
W	1.7	3.6	2.1	3.8			11.3	14.3
NW	.8	9.9	9.6	4.2			20.5	15.6
CALM								
TOTAL	7.9	38.9	36.8	16.7			100.0	13.0

MAX WIND
SPEED: 33 KNOTS
DIRECTION: 100 DEG
DAY: 10
HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 234

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY		3.0	12.0	29.5	38.9	15.0	1.3	.4	4.2M	10.0M	(12 06)

PRECIPITATION
NO. OF DAYS WITH PRECIP: 9 NO. OF DAYS WITH REPORTS/ COMPLETE: 28 PARTIAL: 3
NO. OF OBS WITH PAST OR PRESENT PRECIP: 13 NO. OF WEATHER OBS: 243

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE: 19.7% SEVERE: NONE #OBS: 239

JANUARY — DATA SUMMARY — EB12
AVERAGE LATITUDE 26.0N — AVERAGE LONGITUDE 094.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	10.8	(14 09)	21.3	26.1	(01 18)	248	31
DEWPOINT TEMP (DEG C)	01.0	(13 18)	17.3	23.3	(31 21)	248	31
PRESSURE (MBAR)	0999.9	(10 09)	1016.3	1030.9	(19 15)	248	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 248

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	1.6	3.3	8.7	1.2		14.3	20.2
NE		1.2	4.1	.8			6.1	15.9
E	.4	3.7	4.3	2.4			11.0	14.6
SE		7.3	21.6	1.2			28.0	13.5
S		4.1	18.3	3.9	.4		30.2	16.3
SW		.8	3.3	.4			4.5	14.6
W		1.2	2.0				3.3	12.0
NW		.4	1.2	.4			2.4	17.8
CALM								
TOTAL	.8	18.4	44.9	16.3	1.6		100.0	15.7

MAX WIND
SPEED: 33 KNOTS
DIRECTION: 350 DEG
DAY: 25
HOUR: 06

PRECIPITATION
NO. OF DAYS WITH PRECIP: 9 NO. OF DAYS WITH REPORTS/ COMPLETE: 31 PARTIAL: 0
NO. OF OBS WITH PAST OR PRESENT PRECIP: 24 NO. OF WEATHER OBS: 248

JANUARY — DATA SUMMARY — EB13
AVERAGE LATITUDE 32.3N — AVERAGE LONGITUDE 075.3W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	11.0	(15 12)	19.4	23.7	(31 21)	248	31
DEWPOINT TEMP (DEG C)	03.1	(15 12)	14.0	21.7	(21 06)	248	31
SEA TEMP (DEG C)	21.9	(09 15)	22.7	23.9	(02 09)	91	12
AIR-SEA TEMP (DEG C)	-11.4	(02 18)	-03.3	00.3	(01 21)	91	12
PRESSURE (MBAR)	1007.3	(26 00)	1021.2	1031.8	(18 06)	248	31

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 248

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.4	3.6	6.0	.4			10.1	12.9
NE	.4	3.0	4.4				7.3	11.3
E	.4	2.4	4.4	1.2			8.9	14.4
SE		.8	3.6	2.8			7.3	19.1
S		3.2	8.1	14.5	.8		26.2	22.5
SW	.4	3.6	4.0	6.0			14.1	18.4
W	.8	3.2	6.9	4.4	.4		15.7	16.5
NW		2.4	6.9	1.2			10.5	16.1
CALM								
TOTAL	2.8	20.2	45.2	30.6	1.2		100.0	17.6

MAX WIND
SPEED: 34 KNOTS
DIRECTION: 200 DEG
DAY: 25
HOUR: 21

PRECIPITATION
NO. OF DAYS WITH PRECIP: 12 NO. OF DAYS WITH REPORTS/ COMPLETE: 31 PARTIAL: 0
NO. OF OBS WITH PAST OR PRESENT PRECIP: 17 NO. OF WEATHER OBS: 248

FEBRUARY — DATA SUMMARY — EB01
AVERAGE LATITUDE 38.5N — AVERAGE LONGITUDE 073.5W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	03.6	(14 12)	12.8	23.3	(25 00)	223	28
DEWPOINT TEMP (DEG C)	-02.5	(08 15)	07.8	21.4	(24 15)	223	28
SEA TEMP (DEG C)	10.4	(18 09)	22.1	24.8	(25 00)	223	28
AIR-SEA TEMP (DEG C)	-10.9	(14 09)	-09.3	04.2	(18 07)	223	28
PRESSURE (MBAR)	1002.9	(12 21)	1018.9	1033.7	(04 15)	223	28

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 222

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.9	4.1	17.1	2.7			24.8	15.2
NE		1.4	4.5	.5			6.3	13.7
E			.9				.9	11.1
SE		.5	.5	.9			1.8	17.3
S		.9	5.6	.5			9.0	13.4
SW		.9	3.6	9.5			14.0	22.8
W	1.4	4.5	10.8	8.6	.9		26.1	17.7
NW		3.6	9.9	4.1			17.6	16.3
CALM	3.6						3.6	.0
TOTAL	5.9	15.8	50.9	26.6	.9		100.0	16.4

MAX WIND
SPEED: 35 KNOTS
DIRECTION: 260 DEG
DAY: 23
HOUR: 09

PRECIPITATION
NO. OF DAYS WITH PRECIP: 27 NO. OF DAYS WITH REPORTS/ COMPLETE: 27 PARTIAL: 1
NO. OF OBS WITH PAST OR PRESENT PRECIP: 74 NO. OF WEATHER OBS: 223

FEBRUARY — DATA SUMMARY — EB03
AVERAGE LATITUDE 36.0N — AVERAGE LONGITUDE 147.9W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-05.9	(13 15)	00.7	04.3	(07 21)	222	28
DEWPOINT TEMP (DEG C)	-09.4	(12 12)	-02.7	03.9	(25 09)	217	28
PRESSURE (MBAR)	0986.6	(21 09)	1002.4	1033.9	(05 12)	222	28

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 222

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.8	8.6	4.5				14.9	8.4
NE	1.8	11.7	2.7				16.2	7.3
E	2.3	9.1	2.3	.5			15.1	7.7
SE	1.4	2.7	7.7	2.3			14.0	13.7
S	.9	5.9	2.7				9.5	7.6
SW	1.4	5.4	2.7				9.5	8.8
W	1.8	4.5	3.6	.9			10.8	9.8
NW	1.8	5.6	4.1	1.8			11.3	12.0
CALM	.9						.9	.0
TOTAL	14.0	50.5	30.2	5.4			100.0	9.3

MAX WIND
SPEED: 27 KNOTS
DIRECTION: 300 DEG
DAY: 19
HOUR: 12

WAVES - % FREQUENCIES, MEAN AND EXTREME (METERS) — NO. OF WAVE OBS: 221

HEIGHT (M)	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	MEAN	MAX	(DA HR)
% FREQUENCY		22.2	22.2	21.7	25.8	7.7	.5		3.3M	8.0M	(19 12)

PRECIPITATION
NO. OF DAYS WITH PRECIP: 7 NO. OF DAYS WITH REPORTS/ COMPLETE: 26 PARTIAL: 2
NO. OF OBS WITH PAST OR PRESENT PRECIP: 16 NO. OF WEATHER OBS: 222

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE: 4.5% SEVERE: NONE #OBS: 222

FEBRUARY — DATA SUMMARY — EB12
AVERAGE LATITUDE 26.0N — AVERAGE LONGITUDE 094.0W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	13.2	(24 00)	21.5	27.0	(18 21)	223	28
DEWPOINT TEMP (DEG C)	01.6	(24 09)	17.4	23.3	(01 03)	223	28
PRESSURE (MBAR)	1005.5	(22 18)	1016.4	1029.2	(07 18)	222	28

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 222

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	.9	2.7	9.5	4.1			17.1	16.7
NE	.5	3.6	2.7				6.8	9.7
E	1.8	4.1	3.2				9.0	8.4
SE	.9	8.6	12.2				21.6	11.1
S	1.4	7.7	20.3	3.6			32.9	14.4
SW	.5	.9	1.8				3.2	10.9
W		.9	.9				1.8	11.1
NW	.5	.9	1.8	4.1	.5		7.7	21.8
CALM								
TOTAL	5.9	29.3	52.3	11.7	.5		100.0	13.6

MAX WIND
SPEED: 38 KNOTS
DIRECTION: 330 DEG
DAY: 23
HOUR: 12

PRECIPITATION
NO. OF DAYS WITH PRECIP: 7 NO. OF DAYS WITH REPORTS/ COMPLETE: 27 PARTIAL: 1
NO. OF OBS WITH PAST OR PRESENT PRECIP: 10 NO. OF WEATHER OBS: 223

FEBRUARY — DATA SUMMARY — EB13
AVERAGE LATITUDE 32.3N — AVERAGE LONGITUDE 075.2W

MEANS AND EXTREMES	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	13.1	(08 03)	19.3	23.9	(01 21)	223	28
DEWPOINT TEMP (DEG C)	03.4	(08 12)	14.9	22.8	(19 21)	222	28
PRESSURE (MBAR)	1006.7	(07 09)	1018.9	1029.1	(22 15)	223	28

WIND - % FREQUENCIES, MEANS AND EXTREMES — NO. OF OBS: 222

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.8	2.3	5.0				9.0	10.3
NE	.9	2.7	3.6	3.6	.5		11.3	17.1
E	1.8	4.1	3.2	1.4			10.4	11.1
SE	.5	.5	2.3	1.8			5.0	18.8
S	.9	1.4	10.8	9.5			21.6	20.1
SW	.5	2.3	10.8	4.5	.5		18.5	17.6
W		3.2	7.7	3.6			14.4	16.2
NW		2.3	7.2	.5			9.9	14.8
CALM								
TOTAL	5.9	18.5	50.5	24.3	.9		100.0	16.3

MAX WIND
SPEED: 33 KNOTS
DIRECTION: 240 DEG
DAY: 23
HOUR: 06

PRECIPITATION
NO. OF DAYS WITH PRECIP: 8 NO. OF DAYS WITH REPORTS/ COMPLETE: 27 PARTIAL: 1
NO. OF OBS WITH PAST OR PRESENT PRECIP: 22 NO. OF WEATHER OBS: 223

(Continued on page 252.)

Table 8
Selected Gale and Wave Observations, North Atlantic
January and February 1975

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves Period sec.	Sea Waves Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.	Swell Waves Height ft.
NORTH ATLANTIC OCEAN		JAN.															
SS DAVID D IRWIN	AMERICAN	2	35.9 N	74.8 W	06	33	45	10 NM	00	1015.2	12.0	17.8	6	13			
MV CASUARINA	DANISH	2	36.5 N	73.1 W	12	32	M 45	2 NM	25	1019.0	8.0	22.0	11	19.5			
MV CAPE FREELS	LIBERIAN	2	41.3 N	60.0 W	18	29	48	2 NM	02	994.0	11.0		5	8			
MV ATLANTICA LIVORNO	GERMAN	2	42.0 N	54.4 W	12	19	45	5 NM	65	988.0	14.0	12.0			18	6	26
SS ANCHORAGE	AMERICAN	2	37.5 N	64.6 W	18	34	50	5 NM	16	1003.0	11.1	22.2	8	29.5			
SS STAGHOUND	AMERICAN	2	41.9 N	63.9 W	18	30	45	10 NM	02	1000.0	3.4	7.4			30	8	11.5
MV CAPE FREELS	LIBERIAN	3	39.5 N	63.5 W	12	32	48	2 NM	02	1014.0	8.0		5	8			
SS ALMERIA LYKES	AMERICAN	3	31.9 N	31.2 W	12	27	45	5 NM	18	1001.6	16.7	19.4	9	16.5			
SS AUSTRAL PILOT	AMERICAN	3	35.0 N	60.5 W	12	32	50	> 25 NM	02	1009.4	13.4	19.5	5	19.5	32	8	29.5
SS WILLIAM H ALLEN	LIBERIAN	3	36.7 N	64.9 W	00	34	42	5 NM	25	1013.9	8.9	20.0	7	19.5			
MV CORSICANA	LIBERIAN	4	37.4 N	37.3 W	00	13	M 60	5 NM	01	1020.0	18.0	18.8			13	12	32.5
SS LASH ESPANA	AMERICAN	6	41.2 N	46.8 W	18	27	43	10 NM	02	1003.5	6.7	16.1	7	8	27	10	11.5
SS LASH ESPANA	AMERICAN	7	41.3 N	44.9 W	00	27	44	10 NM	02	1009.5	6.1	17.8			27	11	10
SS GAGE LUND	LIBERIAN	7	38.0 N	56.9 W	06	36	42	10 NM	03	1030.8	11.5	22.5	5	13	34	6	23
MV ALMIRANTE	HONDURAN	7	35.8 N	41.2 W	12	35	45	5 NM	01	1014.9	15.0	20.0	2	8	35	7	18
SS DEFIANCE	AMERICAN	9	38.7 N	47.9 W	12	25	32	10 NM	02	1007.1	16.7	17.8	10	16.5	25	>13	32.5
MV TROLL RIVER	BRITISH	9	35.6 N	48.4 W	00	26	65	10 NM	03	1015.1	13.0						
SS EXPORT FREEDOM	AMERICAN	10	47.0 N	47.2 W	00	06	45	2 NM	63	1002.0	3.3	1.1	6	10	04	8	16.5
SS OVERSEAS JUNEAU	AMERICAN	10	35.0 N	60.8 W	12	27	45	5 NM	18	993.9	18.3	17.8	5	14.5	27	< 6	24.5
SS AMER ACE	AMERICAN	10	45.3 N	39.7 W	18	30	55	5 NM	02	1000.0	10.0	15.6	6	26			
SS STAGHOUND	AMERICAN	10	44.1 N	39.4 W	18	02	50	2 NM		995.9	10.0	14.5			03	8	16.5
SS AMER LEADER	AMERICAN	11	43.3 N	35.9 W	06	34	42	10 NM	01	1009.0	8.9	14.4	4	10	34	6	16.5
MV PLAN DE SAN LUIS	MEXICAN	12	21.3 N	97.1 W	18	36	50	10 NM	02	1015.0	19.0	24.0	12	10			
MV PLAN DE SAN LUIS	MEXICAN	13	21.9 N	97.3 W	12	36	60	2 NM	60	1026.0	10.5	20.0	10	16.5			
SS LIGHTNING	AMERICAN	13	46.1 N	38.9 W	18	29	50	5 NM	26	999.0	8.8	14.0	8	19.5	26	>13	18
SS GAGE LUND	LIBERIAN	13	47.0 N	11.9 W	18	18	40	5 NM		991.2	11.0	15.5	4	29.5	18	< 6	32.5
SS AMER ARCHER	AMERICAN	13	46.7 N	14.0 W	18	18	50	2 NM	62	983.0	12.8	12.8			20	9	16.5
USNS TALLULAH	AMERICAN	13	46.2 N	13.5 W	18	14	50	1 NM		982.4	8.3	16.2	2	24.5	16	13	32.5
SS STAGHOUND	AMERICAN	13	49.7 N	10.9 W	18	18	50	5 NM	02	980.7	11.7	12.8			18	9	10
SS AMER LEADER	AMERICAN	14	41.0 N	62.2 W	18	27	48	2 NM	51	990.5	15.6	17.8	4	13	27	7	23
USNS TALLULAH	AMERICAN	14	47.3 N	13.8 W	00	07	40	5 NM	00	985.8	8.3	16.2	2	24.5	07	13	32.5
SS EXPORT PATRIOT	AMERICAN	14	39.0 N	62.0 W	06	24	49	10 NM	02	1009.8	18.4	18.9	6	14.5	18	< 6	11.5
SS MOBIL AERO	AMERICAN	14	39.3 N	70.1 W	06	30	47	1 NM	11	1003.0	10.0	14.5	9	19.5	18	10	19.5
SS AMER LEADER	AMERICAN	15	40.8 N	63.8 W	00	30	45	10 NM	02	1006.0	8.3	22.0	6	13	30	9	24.5
MV BAJKA	NORWEGIAN	15	30.0 N	17.3 W	18	33	44	> 25 NM	01	1019.0	18.3	22.0			32	8	16.5
MV GRETE MAERSK	DANISH	17	44.2 N	26.8 W	18	26	55	5 NM	03	1021.0	12.5	14.0					
SS AMER ARCHER	AMERICAN	18	42.1 N	60.9 W	12	31	50	5 NM	70	1033.2	- 3.9	13.4			29	>13	16.5
SS SEALAND VENTURE	AMERICAN	18	44.0 N	14.7 W	18	35	45	10 NM	02	1028.6	12.0	16.0	8	18			
SS TILLIE LYKES	AMERICAN	18	46.9 N	10.2 W	12	36	45	10 NM	82	1009.5	14.4	11.1	12	28			
MV EMS ORE	LIBERIAN	18	47.5 N	14.0 W	00	30	56	2 NM	90	997.6	9.6	10.0	XX	39			
MV LEON	HONDURAN	18	45.8 N	14.5 W	00	28	47	5 NM	18	1005.8	8.9	15.0	5	16.5			
MV GRETE MAERSK	DANISH	18	43.8 N	27.8 W	00	27	50	5 NM	02	1028.0	13.2	11.0					
SS AMER ARGOSY	AMERICAN	19	45.7 N	34.4 W	00	26	45	10 NM	03	1009.0	8.3	13.9					
MV EMS ORE	LIBERIAN	19	44.9 N	18.6 W	00	22	45	5 NM	90	1023.0	13.0	13.0		36			
SS EXXON BOSTON	AMERICAN	19	36.9 N	72.8 W	00	19	45	5 NM	16	1014.6	20.0	18.3	7	8	18	9	11.5
MV GRETE MAERSK	DANISH	19	40.4 N	35.5 W	06	27	41	> 25 NM	81	1024.0	12.8						
SS AMER ARGOSY	AMERICAN	20	43.7 N	45.6 W	18	20	42	5 NM	62	1020.0	14.5	13.6					
SS EXXON JAMESTOWN	AMERICAN	20	33.4 N	75.1 W	12	23	M 43	2 NM	64	1007.1	21.0	24.4	5	6.5	22	7	11.5
MV SYLVO	NORWEGIAN	22	44.1 N	21.5 W	06	26	45	2 NM	25	1028.5	15.0	14.5					
MV SYLVO	NORWEGIAN	24	42.9 N	32.8 W	06	25	42	5 NM	61	1026.8	14.5	15.4	8	11.5	31	10	23
SS BOSTON	AMERICAN	26	35.0 N	75.4 W	12	24	48	10 NM	01	1006.4	17.5	15.5			24	< 6	24.5
SS DELAWARE SUN	AMERICAN	26	37.4 N	68.8 W	18	25	41	5 NM	16	1001.7	19.0	22.3			25	11	21
SS EXXON WASHINGTON	AMERICAN	26	33.4 N	75.3 W	00	24	50	10 NM	02	1002.3	23.5	22.2	5	14.5			
SS PANAMA	AMERICAN	26	34.5 N	73.5 W	18	27	42	5 NM	02	1006.1	20.0	24.4	10	13			
SS OVERSEAS JUNEAU	AMERICAN	26	37.6 N	72.6 W	12	23	45	10 NM	01	999.0	12.3	11.6	3	8	17	9	16.5
SS EXFORD	AMERICAN	27	48.7 N	10.0 W	12	29	50	10 NM	02	1008.5	7.3	11.7	8	19.5			
SS DELAWARE SUN	AMERICAN	27	37.5 N	67.5 W	00	29	50	5 NM	81	1004.4	16.0	23.3					
MV OGDEN THAMES	LIBERIAN	27	46.5 N	07.0 W	12	23	M 45	5 NM	80	1010.5	10.0	12.0	4	13	28	< 6	19.5
SS LASH ESPANA	AMERICAN	27	39.1 N	59.3 W	00	22	46	5 NM	02	1005.0	19.4	18.3	5	10	22	7	14.5
MV CASSARATE	SWISS	27	47.0 N	07.7 W	00	24	48	2 NM	50	1004.5	12.2	10.0			26	X	18
SS EXPORT FREEDOM	AMERICAN	29	45.7 N	18.4 W	18	23	48	5 NM	02	1001.0		13.4	8	23	29	10	16.5
SS DOLLY TURMAN	AMERICAN	29	45.3 N	33.7 W	12	27	47	10 NM	01	993.6	8.3	12.2	8	8	27	7	11.5
SS ZIM HONGKONG	LIBERIAN	29	41.3 N	45.2 W	12	28	45	10 NM	03	1012.0	6.0		5	10			
SS DOLLY TURMAN	AMERICAN	30	43.3 N	38.4 W	18	23	47	5 NM	18	996.3	12.2	12.8	8	10	23	< 6	14.5
SS EXPORT BUYER	AMERICAN	30	40.9 N	61.2 W	12	28	45	5 NM	01	992.0	13.4	20.0	8	11.5	27	8	32.5
SS GEORGE M KELLER	LIBERIAN	30	40.0 N	62.0 W	12	27	M 65	5 NM	82	990.0	14.0	20.5			27	X	24.5
SS OVERSEAS ULLA	AMERICAN	30	35.9 N	73.4 W	06	25	60	5 NM	01	1010.0	20.0	16.7			25	7	19.5
SS ZIM HONGKONG	LIBERIAN	30	42.5 N	57.8 W	18	34	45	2 NM	50	988.5	2.0	10.0	4	8	25	7	13
SS EXPORT FREEDOM	AMERICAN	31	43.4 N	31.0 W	18	19	30	1 NM	64	992.0	11.7	14.0	7	19.5	20	10	21
SS DOLLY TURMAN	AMERICAN	31	40.5 N	40.1 W	12	27	48	5 NM	02	989.5	10.6	13.3	6	10	27	7	23
SS GEORGE M KELLER	LIBERIAN	31	40.4 N	63.5 W	00	32	M 50	2 NM	91	1014.0	7.0	20.0			32	X	41
SS AMER ARCHER	AMERICAN	31	42.7 N	39.9 W	12	26	35	5 NM	90	987.0	5.5	13.8	13	29.5			
MV ATLANTICA LIVORNO	GERMAN	31	39.1 N	39.8 W	12	27	32	5 NM	20	995.0	12.0				27	9	13
SS EXPORT PATRIOT	AMERICAN	31	42.8 N	42.7 W	18	31	30	5 NM	70	996.6	2.2	17.5			32	10	14.5
OCEAN STATION VESSELS																	
ATLANTIC H																	
USCGC INGHAM	AMERICAN	2	38.0 N	71.0 W	12	33	M 30	5 NM	13	1010.8	8.4	14.8	9	18			
USCGC TANEY	AMERICAN	10	38.0 N	71.0 W	00	30	30	5 NM	07	1013.1	10.8	14.3	8	21			
USCGC TANEY	AMERICAN	18	38.0 N	71.0 W	21	17	41	10 NM	80	1020.2	14.4	14.4	7	13			
USCGC TANEY	AMERICAN	19	38.0 N	71.0 W	03	19	58	5 NM	80	1012.3	16.1	13.3	9	23			
USCGC TANEY	AMERICAN	21	38.0 N	71.0 W	00	04	41	5 NM	61	1010.2	8.2	14.8	6	14.5			
USCGC DUANE	AMERICAN	26	38.0 N	71.0 W	15	27	M 53	5 NM	07	1001.6	15.8	18.2	11	26			
GREAT LAKES VESSELS																	
SS CHARLES M WHITE	AMERICAN	11	42.5 N	87.2 W	12	23	M 34	2 NM	71		- 4.0	6.0	14	11.5			
SS PHILLIP R CLARKE	AMERICAN	11	43.3 N	87.8 W	18	24	M 44	10 NM	03		- 7.0	4.0	10	13			
SS MIDDLETOWN	AMERICAN	12	47.6 N	87.2 W	06	23	M 45	1 NM	22		-18.0	3.0	8	14.5			

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves* Period sec.	Sea Waves* Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.*	Swell Waves Height ft.
NORTH ATLANTIC OCEAN		JAN.															
SS EDMUND FITZGERALD	AMERICAN	12	45.4 N	83.5 W	06	25	M 50	5 NM	22		- 8.0	2.0	8	11.5			
SS ASHLAND	AMERICAN	12	46.9 N	91.5 W	06	26	M 44	1 NM	28		-21.0	3.0	4	6.5			
SS PHILLIP R CLARKE	AMERICAN	21	46.8 N	86.0 W	00	18	M 45	10 NM	02		-18.0	5.0	10	10			
NORTH ATLANTIC OCEAN		FEB.															
MV ATLANTICA LIVORNO	GERMAN	1	39.3 N	42.0 W	00	30	45	2 NM	82	1004.5	6.0		2	8	27	8	13
SS DOLLY TURMAN	AMERICAN	1	40.5 N	43.0 W	12	32	41	10 NM	01	1009.1	3.3	16.1	6	6.5	32	8	19.5
SS DOLLY TURMAN	AMERICAN	2	40.2 N	53.0 W	12	34	60	5 NM	03	1012.9	4.4	13.9			34	12	19.5
SS DOLLY TURMAN	AMERICAN	4	40.2 N	64.8 W	00	27	35	5 NM	03	1014.6	3.0	17.8			27	10	19.5
SS SEALAND CONSUMER	AMERICAN	5	29.8 N	45.4 W	06	32	45	10 NM	02	1019.3	13.6	19.5	8	13	32	13	19.5
SS AMER LEGEND	AMERICAN	9	48.4 N	48.0 W	18	29	50	5 NM	07	998.0	0.5	2.3	3	13	29	9	24.5
MV ACADIA FOREST	NORWEGIAN	9	37.8 N	34.7 W	18	29	M 45	10 NM	02	1011.0	16.0	16.0		14.5	27	X	19.5
SS AMER LEGEND	AMERICAN	10	45.1 N	55.3 W	18	31	50	2 NM	70	997.0	- 3.5	0.0	9	13			
MV ACADIA FOREST	NORWEGIAN	10	37.4 N	36.4 W	00	29	M 45	10 NM	02	1018.0	14.0			14.5	27	X	19.5
SS LIGHTNING	AMERICAN	10	41.4 N	60.3 W	12	33	45	5 NM	07	1005.8	1.7	14.0	3	10	30	6	19.5
MV BELLA MAERSK	DANISH	10	48.6 N	40.4 W	06	29	50	2 NM	25	999.0	5.2		7	21			
MV ROLAND	SWEDISH	12	39.0 N	49.4 W	00	25	44	5 NM	25	1011.0	17.5	18.0	5	10			
SS TRINITY	AMERICAN	13	36.7 N	68.6 W	00	25	45	5 NM	18	996.2	21.0	21.7	3	6.5			
SS AMER ARCHER	AMERICAN	13	50.3 N	26.0 W	18	30	50	5 NM	20	1000.2	6.1	9.5	5	10	31	12	24.5
SS EXPORT PATRIOT	AMERICAN	14	40.6 N	38.6 W	18	23	45	2 NM	25	1003.0	16.7	15.6	4	6.5	24	7	11.5
SS SEALAND RESOURCE	AMERICAN	15	35.4 N	53.6 W	18	29	45	10 NM	81	1016.0	14.5	18.0	5	16.5	29	9	21
SS AMER ARCHER	AMERICAN	15	45.2 N	39.3 W	18	22	45	2 NM	63	998.3	5.6	12.3	3	6.5	23	8	14.5
SS EXPORT PATRIOT	AMERICAN	15	40.5 N	43.4 W	18	27	50	2 NM	65	1007.8	12.3	15.6	8	14.5	23	10	16.5
SS AMER ARGOSY	AMERICAN	16	50.0 N	24.2 W	00	23	45	5 NM	01	1000.3	8.9	11.7					
SS COLORADO	AMERICAN	16	33.1 N	78.1 W	18	19	41	5 NM	02	1018.0	22.8	22.2	8	11.5			
SS AMER ARGOSY	AMERICAN	18	47.7 N	39.1 W	12	28	50	1 NM	72	1001.2	2.2	13.3	13	28			
MV BALAO	NORWEGIAN	18	50.2 N	23.4 W	18	20	45	5 NM	16	1001.0	11.0	10.0	7	10	18	8	14.5
SS TRANSOREGON	AMERICAN	19	35.2 N	74.8 W	18	24	45	10 NM	02	1004.9	20.0	22.2			26	6	6.5
SS GREAT REPUBLIC	AMERICAN	21	46.8 N	23.1 W	18	19	45	2 NM	10	1002.5	11.2	10.7	6	11.5	23	8	19.5
SS EXFORD	AMERICAN	21	42.8 N	28.0 W	18	24	45	2 NM	25	1015.1	12.8	13.4	8	14.5			
MV EMS ORE	LIBERIAN	23	42.6 N	21.2 W	12	18	44	5 NM	03	1012.5	13.9	12.0	5	6.5	29	10	21
SS GREAT REPUBLIC	AMERICAN	23	44.0 N	35.5 W	18	27	48	5 NM	02	988.8	5.6	10.6	8	16.5	27	8	31
SS EXFORD	AMERICAN	23	42.1 N	40.9 W	18	29	60	5 NM	26	1000.3	3.3	14.0	9	29.5			
SS AMER ACE	AMERICAN	23	44.4 N	38.9 W	18	32	45	5 NM	88	990.2	3.9	12.2	4	10	32	6	13
SS AMER LEGEND	AMERICAN	23	46.2 N	25.2 W	12	16	50	5 NM	02	998.5	10.0	11.1	9	16.5			
SS EXFORD	AMERICAN	24	42.0 N	41.2 W	00	28	50	5 NM	23	1008.5	5.7	14.0	9	31			
SS MARYLAND TRADER	AMERICAN	24	27.6 N	91.5 W	00	29	45	5 NM	07	1013.2	15.6	23.9	6	11.5			
SS SEALAND RESOURCE	AMERICAN	24	39.7 N	34.7 W	18	25	55	1 NM		1000.0	15.0	14.0			25	10	29.5
MV EMS ORE	LIBERIAN	25	34.8 N	31.3 W	18	28	45	5 NM	81	1006.4	13.5	16.0	6	11.5	27	9	32.5
SS GREAT REPUBLIC	AMERICAN	25	43.3 N	43.1 W	06	29	45	2 NM	18	1010.2	3.3	10.6	6	14.5	29	8	26
SS STAGHOUND	AMERICAN	25	42.8 N	35.3 W	18	31	45	5 NM	03	993.0	6.0	13.0	4	5	31	9	41
MV SERAFIN TOPIC	LIBERIAN	25	41.1 N	26.0 W	06	18	47	2 NM	81	995.0	13.0	13.0	6	13			
SS EXPORT PATRIOT	AMERICAN	26	39.6 N	38.5 W	12	33	46	10 NM	15	1011.2	10.0	14.5			34	10	14.5
MV EMS ORE	LIBERIAN	26	34.1 N	32.5 W	00	28	50	10 NM	82	1009.5	11.8	17.0	5	16.5	28	9	37.5
SS EXPORT LEADER	AMERICAN	26	37.2 N	36.7 W	12	32	48	10 NM	21	1009.8	10.0	16.2	9	14.5	32	9	23
SS EXFORD	AMERICAN	27	40.6 N	64.6 W	12	27	45	10 NM	01	1013.5	9.2	17.3	8	23			
SS TILLIE LYKES	AMERICAN	27	43.1 N	10.9 W	18	16	43	5 NM	02	1004.5	13.9	13.4	11	13			
SS AMER COURIER	AMERICAN	27	37.6 N	31.6 W	00	30	42	10 NM	02	1001.0	12.2	16.1	6	11.5	31	9	24.5
MV SERAFIN TOPIC	LIBERIAN	27	36.1 N	32.6 W	06	32	45	5 NM	03	1006.0	13.0	17.0	9	19.5	30	< 6	36
SS AMER LEGACY	AMERICAN	28	46.0 N	37.5 W	18	28	55	5 NM	18	1006.5	10.0	12.8			28	10	41
OCEAN STATION VESSELS																	
ATLANTIC H																	
USCGC TANEY	AMERICAN	25	38.0 N	71.0 W	18	24	50	10 NM	01	1009.0	13.3	13.8	8	16.5			

* Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 35 kt or waves ≥ 25 ft from May through August (≥ 41 kt or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest wind speed was selected.

(Continued from page 250.)

JANUARY DATA SUMMARY E833
AVERAGE LATITUDE 38.5N AVERAGE LONGITUDE 141.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-08.7	(07 18)	00.9	08.2	(23 03)	182	31
SEA TEMP (DEG C)	04.7	(15 09)	05.4	08.8	(01 00)	184	31
AIR-SEA TEMP (DEG C)	-11.9	(07 18)	-04.9	20.7	(23 03)	177	31
PRESSURE (MBAR)	0965.6	(12 15)	1004.8	1029.3	(26 12)	178	31

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N		2.8	.6				3.4	7.7
NE		1.1	6.1	12.8			20.1	22.3
E		4.5	8.4	8.4	1.1		22.3	19.3
SE		2.2	7.3	1.1			10.6	15.3
S		.6	7.3				7.8	14.0
SW		.6	7.3	2.8			10.6	18.8
W		.6	19.6	3.4			23.5	17.3
NW			1.1	.6			1.7	21.3
CALM								
TOTAL		12.3	57.3	29.1	1.1		100.0	18.2

NO. OF OBS: 179

MAX WIND
SPEED: 36 KNOTS
DIRECTION: 080 DEG
DAY: 12
HOUR: 03

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE: 19.2% SEVERE: NONE #OBS: 177

FEBRUARY DATA SUMMARY E833
AVERAGE LATITUDE 38.5N AVERAGE LONGITUDE 141.0W

MEANS AND EXTREMES

	MIN	(DA HR)	MEAN	MAX	(DA HR)	NO. OF OBS	DAYS WITH DATA
AIR TEMP (DEG C)	-05.7	(12 15)	00.7	08.7	(07 03)	175	27
SEA TEMP (DEG C)	03.7	(16 21)	04.6	05.9	(09 18)	186	28
AIR-SEA TEMP (DEG C)	-10.2	(12 15)	-03.7	02.0	(07 03)	175	27
PRESSURE (MBAR)	0969.3	(19 03)	1004.7	1029.3	(08 09)	175	28

WIND - % FREQUENCIES, MEANS AND EXTREMES

DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL %	MEAN SPEED (KNOTS)
N	1.1	10.2	3.4				14.8	8.8
NE		1.7	6.3	4.0			13.1	17.7
E	2.3	2.3	6.3	9.1	1.1		21.0	20.6
SE		3.4	8.5	5.7			17.4	17.9
S	1.7	1.7	3.4	.6			7.4	11.8
SW	1.1	2.8	6.3	1.1			11.4	13.0
W		4.0	5.7				9.7	13.3
NW		4.0	.6	.6			5.1	9.8
CALM								
TOTAL	6.8	30.1	40.9	21.0	1.1		100.0	15.3

NO. OF OBS: 176

MAX WIND
SPEED: 36 KNOTS
DIRECTION: 110 DEG
DAY:
HOUR: 14

% OF OBS WITH POTENTIAL SUPERSTRUCTURE ICING MODERATE: 14.5% SEVERE: NONE #OBS: 166

Table 9
Selected Gale and Wave Observations, North Pacific

January and February 1975

Vessel	Nationality	Date	Position of Ship: Lat. deg.	Position of Ship: Long. deg.	Time GMT	Wind: Dir. 10°	Wind: Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C: Air	Temperature °C: Sea	Sea Waves*: Period sec.	Sea Waves*: Height ft.	Swell Waves: Dir. 10°	Swell Waves: Period sec.*	Swell Waves: Height ft.
NORTH PACIFIC OCEAN		JAN.															
SS INGER	AMERICAN	1	32.8 N	119.8 W	00	04	45	> 25 NM	00	1019.3	12.2	15.6	5	14.5			
MV SYUKO MARU	JAPANESE	1	47.3 N	159.1 W	18	34	M 58	.25 NM	07	993.0	2.0	4.0	10	24.5			
MV VAN CONQUEROR	LIBERIAN	1	48.0 N	146.2 W	00	27	M 45	10 NM	02	1015.0	8.0	8.0					
SS SEALAND COMMERCE	AMERICAN	1	46.7 N	162.4 W	18	35	41	5 NM	01	1007.1	2.8	5.0	5	11.5	35	6	16.5
MV EASTERN OCEAN	LIBERIAN	1	45.7 N	154.9 W	12	14	M 47	2 NM	65	1010.0	8.7	8.5	9	8	28	9	13
SS HILLYER BROWN	AMERICAN	1	53.2 N	138.3 W	12	26	45	10 NM	15	1014.0	3.9	7.2	4	14.5	27	8	26
SS JAPAN BEAR	AMERICAN	1	44.4 N	155.5 W	18	24	M 53	1 NM		1001.3	6.7	6.7			22	12	24.5
MV PAN ASIA	PANAMANIAN	1	45.3 N	154.0 W	00	28	M 45	.25 NM		1001.2	6.0	10.0	15	23	27	>13	32.5
MV VAN CONQUEROR	LIBERIAN	2	48.0 N	151.8 W	00	27	M 45	5 NM	80	998.2	6.0	7.0					
SS WASHINGTON MAIL	AMERICAN	2	49.0 N	146.2 W	12	30	50	2 NM		1004.5	2.2	6.7	5	14.5	29	< 6	19.5
SS J H TUTTLE	AMERICAN	2	48.6 N	128.1 W	18	20	45	5 NM	65	1013.1	7.8	8.9	5	10			
MV FRONTIER	LIBERIAN	2	49.2 N	134.9 W	18	26	M 50	.5 NM		1001.0	7.2		10	19.5			
SS INDIAN MAIL	AMERICAN	2	52.0 N	148.8 W	06	01	41	10 NM	02	985.4	5.0	2.3	5	13			
MV GOLDEN RAY	LIBERIAN	2	47.4 N	139.5 W	12	25	M 55	1 NM	97	1016.5	9.0	9.0	8	16.5	25	8	28
MV EASTERN OCEAN	LIBERIAN	2	46.6 N	152.1 W	00	25	M 52	1 NM		990.0	6.5	8.5	8	16.5	20	8	32.5
SS JAPAN BEAR	AMERICAN	2	43.7 N	152.3 W	00	29	M 55	10 NM	02	1011.5	7.2	6.7			29	< 6	32.5
MV DAISHOWA VENTURE	LIBERIAN	2	46.7 N	176.7 E	00	28	M 45	2 NM	70	994.0	0.0	6.5	4	13	29	6	29.5
SS HILLYER BROWN	AMERICAN	2	56.2 N	144.4 W	12	34	60	2 NM	27	984.5	- 0.6	4.4	XX	29.5			
MV KINYO MARU	JAPANESE	2	45.1 N	179.5 W	00	25	M 46	5 NM	02	999.0	5.0	5.0	4	8	17	6	11.5
SS NEWARK	AMERICAN	2	53.3 N	135.5 W	12	18	45	10 NM	61	983.0	5.5	5.5	4	10	20	12	23
MV MANDARIN VENTURE	LIBERIAN	2	47.1 N	135.6 W	18	28	M 46	2 NM	07	1015.7	6.1	8.0	10	11.5	26	>13	26
SS HILLYER BROWN	AMERICAN	3	57.0 N	146.1 W	00	27	45	2 NM	28	995.5	- 6.7	4.4	4	26			
SS GALVESTON	AMERICAN	3	55.3 N	138.5 W	06	30	50	10 NM	01	1006.8	0.0	7.3	8	13	30	11	23
SS J H TUTTLE	AMERICAN	3	50.8 N	128.9 W	06	27	45	10 NM	01	1017.5	4.4	7.2	6	10	27	10	19.5
MV KINYO MARU	JAPANESE	3	48.4 N	167.0 W	18	12	M 55	2 NM	79	984.0	4.0	6.0			13	8	19.5
SS NEWARK	AMERICAN	3	52.2 N	133.3 W	00	28	45	5 NM	60	1002.5	3.8	6.2	4	10	31	10	19.5
SS SANTA MARIA	AMERICAN	3	54.3 N	141.7 W	06	29	45	5 NM	70	1007.8	0.0	4.4	5	8	29	9	23
MV VAN CONQUEROR	LIBERIAN	3	47.1 N	158.0 W	06	27	M 50	5 NM	02	1010.0	4.0	7.0					
MV VAN CONQUEROR	LIBERIAN	4	46.4 N	162.8 W	00	26	M 60	2 NM	02	999.3	10.0	7.0					
SS EXXON NEWARK	AMERICAN	5	57.5 N	148.0 W	00	31	45	10 NM	26	997.0	- 8.0	3.5			32	< 6	14.5
SS CANADA BEAR	AMERICAN	5	41.1 N	173.6 E	12	27	43	10 NM	02	998.2	6.7	10.0	4	8	08	9	11.5
SS PHILADELPHIA	AMERICAN	6	52.2 N	132.7 W	00	32	48	5 NM	01	995.6	4.5	10.0	4	11.5	30	6	29.5
SS POLAR ALASKA	LIBERIAN	6	54.2 N	169.8 W	18	06	M 42	10 NM	03	1008.0	1.3	2.0	6	5			
MV VAN CONQUEROR	LIBERIAN	6	44.0 N	178.1 W	18	23	M 45	2 NM	62	995.0	7.0	7.0					
MV MIDAS SEINE	LIBERIAN	7	33.3 N	175.3 E	12	26	M 65	.25 NM	81	999.3	12.2	17.0	7	16.5			
SS THOMAS E CUFFE	AMERICAN	8	36.9 N	171.6 W	06	22	M 44	2 NM	07	1003.5	12.2	13.9	10	32.5			
MV TOYOTA MARU # 10	JAPANESE	8	43.8 N	129.6 W	00	25	M 52	2 NM	25	992.5	12.0	9.0	9	14.5	26	13	21
SS SEALAND TRADE	AMERICAN	8	42.0 N	180.0 W	00	31	52	.5 NM		960.4	3.9	10.0	9	21			
MV KINYO MARU	JAPANESE	8	48.1 N	133.3 W	00	29	M 54	2 NM	03	987.0	6.0	9.0			30	7	16.5
SS PHILADELPHIA	AMERICAN	8	57.7 N	146.4 W	00	36	45	5 NM	88	1003.0	- 3.4	6.7	4	10	36	6	19.5
MV CHALMETTE	LIBERIAN	8	46.2 N	157.4 W	12	15	M 47	2 NM	07	998.6	7.6	5.1	8	6.5			
SS SGT MORRIS E CRAIN	AMERICAN	9	18.7 N	166.5 E	00	07	45	5 NM	18	1013.9	26.1	26.5	6	5			
SS SUMMIT	AMERICAN	9	53.7 N	168.8 W	00	06	65	5 NM	02	992.2	1.2	4.4			05	7	19.5
MV ANDREAS U	NORWEGIAN	9	51.2 N	167.4 W	00	05	50	200 YD	85	983.0		5.0			06	7	19.5
SS EXXON NEWARK	AMERICAN	9	55.0 N	143.0 W	18	11	50	2 NM	93	1010.0	- 1.2	4.5	5	10	11	8	14.5
SS SUMMIT	AMERICAN	10	53.2 N	167.2 W	00	01	55	5 NM	02	1003.4	2.8	4.4			09	6	13
MV EASTERN BUILDER	LIBERIAN	10	41.2 N	169.9 E	06	17	M 41	5 NM	02	1015.0	8.0	11.0	6	8	17	8	11.5
MV MIDAS SEINE	LIBERIAN	10	32.9 N	164.3 E	00	17	M 45	2 NM	15	1007.5	16.0	17.0	4	13			
MV WORLD PELAGIC	LIBERIAN	11	34.2 N	139.6 W	18	13	44	200 YD	38	976.8	2.0	8.0	8	16.5	13	13	36
MV EASTERN BUILDER	LIBERIAN	11	41.2 N	173.2 E	00	13	M 48	5 NM	02	1012.0	8.0	11.0			13	8	13
SS GREEN SPRINGS	AMERICAN	11	30.8 N	144.8 E	12	29	43	10 NM	60	1004.4	14.3	19.4	6	8	29	11	21
SS HILLYER BROWN	AMERICAN	11	59.0 N	151.8 W	18	09	42	1 NM	67	990.0	- 1.1	6.7	2	10	09	6	21
MV CHALMETTE	LIBERIAN	11	48.3 N	128.1 W	18	13	M 42	2 NM	60	1014.6	6.5	7.5	6	6.5	13	7	10
SS WASHINGTON MAIL	AMERICAN	12	52.2 N	136.8 W	12	22	50	2 NM		994.5	5.0	7.8	4	14.5	20	6	24.5
MV WORLD PELAGIC	LIBERIAN	12	53.6 N	140.3 W	06	24	48	.25 NM	39	974.0	4.0	8.0	12	21	24	13	39
MARCONA PIONEER	LIBERIAN	12	29.3 N	142.4 E	12	29	47	10 NM	02	1002.0	19.0	21.0	5	8	29	11	13
MV CORAL ARACADIA	LIBERIAN	12	32.4 N	138.9 W	00	23	M 60	1 NM	07	976.0	5.1	8.0			23	8	16.5
MV EASTERN BUILDER	LIBERIAN	12	41.7 N	175.2 E	00	14	M 54	5 NM	80	1003.5	9.5	10.0			14	8	13
MV WORLD PELAGIC	LIBERIAN	13	52.7 N	142.1 W	00	26	45	.5 NM	24	999.0	4.0	6.0	14	23	26	>13	39
SS SUMMIT	AMERICAN	13	58.6 N	148.8 W	18	29	45	5 NM	02	997.6	5.0	5.5	5	10	29	7	18
SS PRES FILLMORE	AMERICAN	13	28.6 N	145.5 E	06	27	45	10 NM	25	1006.1	16.7	20.0	7	32.5			
MARCONA PIONEER	LIBERIAN	13	30.5 N	141.7 E	00	29	44	10 NM	02	1006.0	11.0	20.0	6	8	29	10	11.5
MV CORAL ARACADIA	LIBERIAN	13	53.4 N	144.5 W	06	28	M 42	2 NM	50	1002.5	2.0	6.0	9	14.5			
SS CHEVRON CALIFORNIA	AMERICAN	13	50.8 N	138.5 W	06	27	45	5 NM	02	1013.2	3.9	6.2	3	8	28	7	13
MV ALNIZAR	LIBERIAN	13	28.2 N	149.8 E	00	27	50	10 NM	02	1008.0	18.8	22.2	15	26			
SS SUMMIT	AMERICAN	14	59.2 N	149.8 W	00	26	60	5 NM	02	998.6	5.6	5.5			26	6	18
MV SALLY MAERSK	LIBERIAN	14	15.6 N	94.8 W	06	35	44	> 25 NM	00	1016.0	20.0	27.0	4	16.5			
MV PRES JOHNSON	AMERICAN	15	37.5 N	177.2 E	12	32	45	10 NM	27	994.9	6.7	12.8					
SS CHEVRON TRANSPORTER	LIBERIAN	15	49.3 N	178.8 W	06	03	43	1 NM	73	973.9	0.0	4.4					
SS SPIRIT OF LIBERTY	AMERICAN	15	28.0 N	126.6 E	18	34	47	10 NM	02	1011.9	16.7	22.8	6	10	XX	X	13
MV LEO	LIBERIAN	16	36.5 N	174.7 E	00	29	M 55	.5 NM		1001.0	14.1	13.0			29	< 6	19.5
MV CORAL ARACADIA	LIBERIAN	16	54.0 N	171.4 W	06	04	M 42	2 NM	56	974.5	- 2.2	4.0					
SS WASHINGTON MAIL	AMERICAN	16	53.3 N	178.6 W	12	02	45	5 NM	88	998.7	- 3.5	3.8	5	16.5	02	8	24.5
MV PRES JOHNSON	AMERICAN	16	37.8 N	178.0 W	00	28	45	5 NM	25	992.0	8.9	13.9	6	8	26	6	20
SS PRES VAN BUREN	AMERICAN	17	35.5 N	152.7 E	00	14	50	2 NM	63	996.3	13.9	17.8			14	6	32.5
SS J H TUTTLE	AMERICAN	17	54.1 N	131.0 W	00	15	45	2 NM	60	997.0	4.4	6.1	8	13			
MV UNION PROGRESS	LIBERIAN	17	38.5 N	147.3 E	00	26	M 46	2 NM	00	995.4	8.0	18.0	XX	19.5			
SS WASHINGTON MAIL	AMERICAN	17	52.1 N	174.9 E	00	36	45	5 NM	22	999.0	- 3.5	1.7	5	16.5	36	9	24.5
MV VAN WARRIOR	LIBERIAN	17	31.3 N	152.1 E	00	14	45	10 NM	00	1003.0	19.0	19.0					
MV VAN WARRIOR	LIBERIAN	19	33.6 N	143.7 E	06	29	50	2 NM	81	1006.5	11.0	20.0					
SS AVILA	AMERICAN	19	57.7 N	169.7 W	00	16	50	2 NM		982.7	5.0	3.3	5	18	17	9	24.5
MV HARBOUR BRIDGE	SINGAPORE	20	47.5 N	149.4 W	12	17	M 45	5 NM	51	1000.5	8.0	10.5					
SS CHEVRON CALIFORNIA	AMERICAN	21	52.8 N	162.0 W	00	15	45	2 NM	51	1000.3	6.7	1.7	4	8			
MV CHALMETTE	LIBERIAN	22	54.1 N	158.6 W	18	29	48	5 NM	02	977.0	1.5	3.0					
SS PRES MONROE	AMERICAN	23	35.6 N	153.9 E	00	20	47	5 NM	25	1000.5	16.7	16.7	13	24.5			
MV MARITIME VICTOR	PANAMANIAN	23	40.6 N	145.7 E	00	34	45	2 NM	26	997.0	1.0	1.5	8	14.5			
SS OREGON MAIL	AMERICAN	23	45.0 N	154.0 E	18	34	45	2 NM	70	999.0	- 3.3	- 2.8	6	8	33	8	14.5
SS ZIM MONTREAL	LIBERIAN	23	32.9 N	149.5 E	00	21	45	5 NM	50	1008.0	18.5	19.0	8	14.5			
SS MICHIGAN	AMERICAN	23	34.5 N	145.2 E	06	32	45	10 NM	02	1013.5	13.2	17.3	4	13	32	6	19.5

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C Air	Temperature °C Sea	Sea Waves Period sec.	Sea Waves Height ft.	Swell Waves Dir. 10°	Swell Waves Period sec.*	Swell Waves Height ft.
NORTH PACIFIC OCEAN		JAN.															
MV ASIA BEAUTY	LIBERIAN	23	38.7 N	162.0 E	00	16	M 53	2 NM	05		15.5	12.0			18	9	16.5
MV CHALMETTE	LIBERIAN	23	53.8 N	160.0 W	00	32	M 58	5 NM	02	990.0		3.0			32	8	11.5
MV ASIA BRAVERY	LIBERIAN	23	41.5 N	167.0 E	12	18	M 58	1 NM	63	997.5	11.0	10.0	3	16.5	18	6	16.5
MV TONAMI MARU	JAPANESE	23	47.0 N	147.9 W	00	25	42	5 NM	02	968.2	6.5	9.0	8	14.5	25	12	23
SS POLAR ALASKA	LIBERIAN	23	50.6 N	165.2 E	18	08	M 58	.5 NM	87	975.0	- 0.3	0.0					
MV CHALMETTE	LIBERIAN	24	53.5 N	175.0 W	18	18	M 60	10 NM	02	986.0	4.0	2.2					
MV ASIA BRAVERY	LIBERIAN	24	43.2 N	171.6 E	06	18	M 55	2 NM	02	990.8	5.0	6.0			18	8	23
SS POLAR ALASKA	LIBERIAN	24	51.4 N	167.2 E	00	05	M 58	.5 NM	87	968.0	0.0	0.0					
MV CHALMETTE	LIBERIAN	25	53.0 N	179.4 W	12	26	M 51	5 NM	02	989.6		2.8	5	10	26	8	18
MV DAISHOWA VENTURE	LIBERIAN	26	41.3 N	160.6 E	00	27	M 48	2 NM	01	1003.5	4.0	6.0			29	9	14.5
MV CHALMETTE	LIBERIAN	26	52.1 N	173.7 E	12	16	M 41	5 NM	01	980.5	2.5	3.0					
MV MIDAS ARROW	LIBERIAN	29	51.1 N	164.8 E	18	21	M 45	.25 NM	80	996.6	0.5	4.0		19.5	21	8	32.5
MV CHALMETTE	LIBERIAN	29	45.3 N	155.8 E	06	31	M 50	5 NM	01	997.0		1.5	7	8			
MV MIDAS ARROW	LIBERIAN	30	51.0 N	164.0 E	00	23	M 41	5 NM	83	981.9	1.0	3.5		23			
MV CHALMETTE	LIBERIAN	30	41.9 N	150.8 E	06	29	M 55	10 NM	01	1007.0		1.0			28	< 6	8
MV ASIA BRAVERY	LIBERIAN	30	54.2 N	138.7 W	06	30	M 48	2 NM	02	1015.0	3.0	4.0			30	8	13
MV ASIA BEAUTY	LIBERIAN	30	48.3 N	139.6 W	18	32	M 47	5 NM	86		5.0	5.0	10	32.5			
MV SONETTE	SWEDISH	30	52.3 N	147.3 W	06	29	41	10 NM	03	1026.0	3.0	6.0		23			
MV QUEENS WAY BRIDGE	JAPANESE	31	37.4 N	135.5 W	18	31	M 42	10 NM	02	1010.0	11.0	15.0	6	16.5	31	9	19.5
SS POLAR ALASKA	LIBERIAN	31	53.7 N	179.3 W	16	23	M 42	5 NM	07	1016.0	3.1	1.0	6	6.5			
SS PHIL MAIL	AMERICAN	31	47.1 N	165.6 E	06	20	50	2 NM	83	998.1	0.6	1.7	7	19.5	20	10	41
MV HONSHU MARU	JAPANESE	31	48.2 N	166.5 E	12	29	M 55	1 NM		993.0	1.0	2.5	11	19.5	26	13	24.5
SS HAWAIIAN ENTERPRISE	AMERICAN	31	22.2 N	155.9 W	18	14	42	5 NM	21	1007.8	21.1	23.3	5	8	14	6	14.5
MV ASIA BEAUTY	LIBERIAN	31	48.2 N	137.6 W	00	32	M 41	5 NM	05		6.0	5.0	8	32.5			
NORTH PACIFIC OCEAN		FEB.															
SS PRES VAN BUREN	AMERICAN	1	37.3 N	133.7 W	00	30	45	5 NM	02	1006.4	8.3	12.8	5	6.5	30	8	29.5
SS ALASKAN MAIL	AMERICAN	3	50.3 N	166.2 E	18	09	45	5 NM	02	976.3	0.6	2.2	5	8	09	8	24.5
SS EXXON NEWARK	AMERICAN	4	44.3 N	128.7 W	12	29	45	5 NM	80	1001.0	11.0	10.5	4	6.5			
MV ASIA ZEBRA	LIBERIAN	4	33.4 N	154.5 W	18	31	M 43	10 NM	15	1011.0	14.0	17.0	10	13			
MV CLARA MAERSK	DANISH	4	34.7 N	142.8 E	12	16	45	2 NM	61	1007.5	15.0	18.0					
BREWSTER	PANAMANIAN	4	34.9 N	163.1 E	17	32	M 45	5 NM	02	1018.0	9.0	16.0	6	10			
MV BAY BRIDGE	SINGAPORE	4	45.2 N	151.6 W	12	09	M 45	5 NM	02	1007.7	6.5	9.0	8	23			
MV WORLD SUPREME	LIBERIAN	5	34.0 N	153.5 E	12	32	M 45	5 NM	50	1012.0	17.0						
MV PLUTOS	GERMAN	5	39.3 N	174.6 W	00	19	42	2 NM	61	1005.5	13.1	10.8	6	8	19	10	16.5
SS PRES POLK	AMERICAN	5	35.4 N	149.6 E	18	36	48	5 NM	02	1011.9	7.2	17.7	12	19.5			
SS ZIM MONTREAL	LIBERIAN	5	33.8 N	148.0 E	18	33	50	5 NM	02	1015.5	9.0	20.0	10	14.5	33	13	19.5
MV WOERMANN SASSANDRA	SINGAPORE	5	52.4 N	169.1 W	12	14	47	5 NM	02	1000.5	6.0	4.0	10	14.5	14	>13	19.5
MV MEDEA	SWEDISH	5	33.3 N	162.4 E	18	19	50	5 NM	03	1002.5	16.0	16.0	XX	16.5	XX	X	13
MV EASTERN BUILDER	LIBERIAN	5	46.8 N	161.0 E	06	32	M 47	5 NM	70	1008.0	- 1.0	5.0	5	8	32	8	16.5
MV ASIA ZEBRA	LIBERIAN	5	33.5 N	147.0 W	18	29	M 44	10 NM	15	1000.0	15.0	17.0	11	13			
MV CLARA MAERSK	DANISH	5	33.0 N	145.5 E	06	27	48	2 NM		1002.8	18.6	18.0		28			
MV BAY BRIDGE	SINGAPORE	5	44.2 N	149.0 W	00	05	M 52	10 NM	02	1011.4	7.0	9.5	8	23			
BREWSTER	PANAMANIAN	5	33.4 N	160.3 E	17	19	M 60	1 NM	59	999.0	14.0	16.5			19	7	14.5
MV TRANSOCEAN TRANSPORT	PHILIPPINE	6	40.7 N	178.3 E	18	16	M 50	200 YD		995.0	12.5	11.7	10	19.5			
MV ORIENTAL DESTINY	LIBERIAN	6	30.7 N	160.8 E	06	34	50	10 NM	02	1011.2	19.0	17.8	9	23	30	>13	32.5
SS PRES POLK	AMERICAN	6	34.4 N	150.0 E	00	35	45	10 NM	01	1022.7	8.9	17.3	12	23	36	>13	26
SS ZIM MONTREAL	LIBERIAN	6	32.7 N	151.9 E	06	33	45	5 NM	03	1022.5	11.2	20.0	9	19.5	37	>13	23
MV MEDEA	SWEDISH	6	32.7 N	161.9 E	12	29	50	5 NM	01	1013.0	10.0	16.0	XX	16.5			
HONGKONG SUCCESS	BRITISH	6	35.0 N	162.0 E	06	27	48	2 NM		998.5	11.0	17.0			27	12	29.5
SS MOBIL EXPORTER	PANAMANIAN	6	29.7 N	161.0 E	06	32	45	5 NM	07	1012.2	18.6	20.6	9	23			
SS CHEVRON HAWAII	AMERICAN	6	49.6 N	138.3 W	12	10	M 53	.5 NM	65	999.9	5.6	4.4	10	34.5			
MV BAY BRIDGE	SINGAPORE	6	45.9 N	139.4 W	06	04	M 56	2 NM		988.6	7.3	9.0	8	23			
BREWSTER	PANAMANIAN	6	33.2 N	158.6 E	05	31	M 42	2 NM		1009.5	14.0	16.5	8	14.5			
PACIFIC GLORY	PANAMANIAN	7	48.4 N	166.6 E	16	26	M 45	5 NM	02	999.7	- 0.5	- 0.5	3	6.5	26	X	16.5
MV WOERMANN SASSANDRA	SINGAPORE	7	51.2 N	176.9 E	12	10	45	5 NM	02	992.0	3.5	4.0	8	6.5	10	11	16.5
MV WORLD SUPREME	LIBERIAN	7	33.5 N	146.2 E	12	23	M 45	5 NM	58	1008.5	10.0						
MV CECILIE MAERSK	DANISH	7	33.0 N	154.7 E	18	17	42	10 NM	02	1020.5	15.9	18.0	5	16.5			
SS CHEVRON HAWAII	AMERICAN	7	47.2 N	137.2 W	12	19	M 47	10 NM	01	997.5	7.1	5.5	5	28	17	11	37.5
SS ARCO SAG RIVER	AMERICAN	7	51.2 N	130.8 W	00	07	48	1 NM		996.2	5.4	3.4	8	24.5	08	8	29.5
MV BERKSHIRE	BRITISH	7	33.1 N	146.3 E	12	16	50	2 NM	25	1008.7	19.0	16.6			15	X	24.5
MV TOYOTA MARU #12	JAPANESE	8	38.8 N	151.2 W	12	30	M 43	5 NM	02	1003.5	8.0	11.0	7	14.5	30	11	18
PACIFIC GLORY	PANAMANIAN	8	46.8 N	162.0 E	12	21	M 42	2 NM		992.5	2.8	0.0	4	6.5	21	< 6	13
SS ARCO ANCHORAGE	AMERICAN	8	25.0 N	169.9 E	00	07	50	5 NM	02	1021.6	20.5	21.0	6	16.5	31	7	21
SS UTAH STANDARD	AMERICAN	10	44.8 N	125.0 W	00	18	44	5 NM	16	994.3	9.4	8.8	4	5	18	8	10
NOAA SHIP OCEANOGRAPHER	AMERICAN	11	58.8 N	141.3 W	18	13	M 42	200 YD	73	1008.8	- 2.9	3.8	4	6.5	14	6	11.5
SS AMER LARK	AMERICAN	11	41.8 N	158.7 W	12	33	M 44	5 NM	02	1000.9	6.7	12.8			33	7	11.5
SS POLAR ALASKA	LIBERIAN	11	50.6 N	165.2 E	18	10	M 41	1 NM	22	1000.0	2.1	0.0	10	10			
MV TOYOTA MARU # 10	JAPANESE	12	44.4 N	129.9 W	00	30	M 45	.5 NM	62	990.7	12.5	10.0	7	11.5			
PACIFIC GLORY	PANAMANIAN	12	35.1 N	140.4 E	12	25	M 45	2 NM		1007.2	6.0	0.5			25	7	10
SS POLAR ALASKA	LIBERIAN	12	53.5 N	173.6 E	18	09	M 72	1 NM	22	987.0	2.2	1.0	15	16.5			
MV VAN CONQUEROR	LIBERIAN	12	48.6 N	176.2 E	18	25	M 53	2 NM	26	987.0	3.0	3.0					
NOAA SHIP OCEANOGRAPHER	AMERICAN	12	59.3 N	142.9 W	12	01	M 48	50 YD	70	996.7	- 5.5	4.0	10	32.5	07	< 6	6.5
SS PRES MONROE	AMERICAN	12	53.3 N	172.2 E	18	09	43	.25 NM	73	983.4	1.3	1.0	XX	16.5	09	13	10
SS IDAHO STANDARD	AMERICAN	12	57.4 N	141.8 W	05	16	45	1 NM	75	1000.5	- 2.7	4.4	3	8			
SS PHILADELPHIA	AMERICAN	13	55.9 N	142.1 W	00	16	45	1 NM	75	987.8	0.0	5.5	3	10	16	< 6	19.5
SS SEALAND FINANCE	AMERICAN	13	52.2 N	174.7 E	12	34	45	5 NM	70	988.1	0.5	1.6		16.5	25	X	19.5
SS POLAR ALASKA	LIBERIAN	13	54.0 N	172.9 E	00	09	M 47	1 NM	22	978.0	2.2	1.0	11	13			
MV VAN FORT	LIBERIAN	13	38.7 N	146.8 E	00	28	M 50	.5 NM	20	1001.5	2.0	13.0					
SS AMER LIBERTY	AMERICAN	13	35.3 N	155.2 E	00	18	43	5 NM	81	1001.5	12.2	10.1	8	13			
SS PRES MONROE	AMERICAN	13	51.8 N	167.2 E	06	27	57	2 NM	85	986.8	- 0.7	1.0			28	12	24.5
MV ROBERTS BANK	LIBERIAN	14	27.1 N	139.1 E	18	34	56	5 NM	61	999.0	19.5	18.5	6	14.5			
SS PRES FILLMORE	AMERICAN	14	42.0 N	173.0 W	18	13	50	5 NM	07	1003.0	8.9	7.8			13	6	19.5
SS CHINA BEAR	AMERICAN	14	44.8 N	167.7 E	18	23	45	5 NM	07	976.7	3.3	3.3	7	13			
MV CRESSIDA	PANAMANIAN	14	50.7 N	171.6 W	00	25	M 43	5 NM	51	995.0	3.0	2.4	5	11.5			
MV TOYAMA	NORWEGIAN	15	38.9 N	150.7 E	12	01	48	1 NM		982.0	4.0	10.0	10	14.5			
MV ROBERTS BANK	LIBERIAN	15	30.4 N	137.0 E	12	32	43	5 NM	01	1005.8	13.0	14.0	5	13	32	6	16.5
SS SEALAND FINANCE	AMERICAN	15	46.2 N	163.0 E	00	28	45	2 NM	70	982.1	0.3	2.7	5	10	30	11	19.5
SS PRES FILLMORE	AMERICAN	15	42.3 N	170.3 W	00	15	50	5 NM	62	998.3	7.2	7.8	6	23			
MV KINGSVILLE	NORWEGIAN	15	34.2 N	165.9 E	21	20	58	2 NM	81	992.5	17.2	15.0					
SS IDAHO STANDARD	AMERICAN	15	52.2 N	130.2 W	04	17	35	2 NM	63	1002.0	5.0	7.2			17	6	11.5
MV HIEI MARU	JAPANESE	15	36.1 N	172.7 W	12	27	M 42	2 NM	60	1003.3	8.5	11.5			20	8	13
SS JAPAN BEAR	AMERICAN	15	37.7 N	160.7 E	18	24	M 55	2 NM	61	966.5	11.7	13.8			22	8	19.5
MV CORVIGLIA	SWISS	15	32.4 N	154.9 E	06	18	45	.5 NM	21	988.5	17.8	17.0	9	23			
SS CHINA BEAR	AMERICAN	16	44.1 N	164.6 E	06	28	52	2 NM	83	990.5	0.6	2.8	9	19.5	28	12	24.5
MV VAN CONQUEROR	LIBERIAN	16	48.7 N	152.7 W	06	17	M 45	2 NM	61	994.0	8.0	5.0					
SS JAPAN BEAR	AMERICAN	16	38.2 N	163.1 E	00	26	M 55	1 NM	10	977.2	8.9	12.2	10	29.5	23	12	29.5
MV ASIA BRIGHTNESS	LIBERIAN	17	41.8 N	173.9 W	06	25	45	10 NM	02	995.0	13.0	11.0	7	19.5	22	9	26
MV HARBOUR BRIDGE	SINGAPORE	18	50.4 N	140.0 W	00	24	M 41	5 NM	50	1000.5	8.0	8.0	5	6.5	25	10	11.5

Vessel	Nationality	Date	Position of Ship: Lat. deg.	Long. deg.	Time GMT	Wind: Dir. 10°	Speed kt.	Visibility n. mi.	Present Weather code	Pressure mb.	Temperature °C: Air	Sea	Sea Waves+: Period sec.	Height ft.	Swell Waves: Dir. 10°	Period sec.*	Height ft.
NORTH PACIFIC OCEAN		FEB.															
SS PHILADELPHIA	AMERICAN	19	57.9 N	149.3 W	12	29	45	2 NM	88	980.4	- 6.1	4.5	6	14.5	29	< 6	29.5
MV TOYAMA	NORWEGIAN	19	39.0 N	157.0 W	18	15	46	.5 NM	64	1008.0	11.0	11.0	8	16.5	18	10	13
SS OREGON MAIL	AMERICAN	19	52.3 N	169.8 E	18	36	60	200 YD	75	997.6	- 3.0	1.1	5	24.5	36	8	29.5
SS SEALAND FINANCE	AMERICAN	20	29.5 N	128.3 E	06	30	45	5 NM	25	1015.5	8.3	21.0	6	11.5	30	8	14.5
MV WORLD SUPREME	LIBERIAN	20	35.2 N	144.3 E	06	07	M 42	2 NM	10	1000.8	8.0						
MV BAY BRIDGE	SINGAPORE	20	31.5 N	179.8 E	18	29	M 43	5 NM	02	1014.0	16.5	18.0	8	19.5			
MV ASIA BRAVERY	LIBERIAN	20	34.9 N	173.5 W	18	28	M 45	2 NM	63	1003.0	11.0	14.0	4	6.5	28	7	10
USCGC YOCONA	AMERICAN	20	44.5 N	124.5 W	00	28	M 45	5 NM	02	1000.0	8.3	10.0	4	5	28	6	10
NOAA SHIP OCEANOGRAPHER	AMERICAN	21	59.8 N	145.3 W	12	11	M 68	1 NM	73	982.0	1.8	3.9	8	36			
MV PLUVIUS	GERMAN	21	36.9 N	169.9 W	12	31	44	5 NM	15	1011.0	8.0	14.0			30	6	16.5
SS CITRUS PACKER	AMERICAN	21	33.0 N	144.7 E	12	28	40	5 NM	03	998.0	11.7	17.2	6	14.5	28	9	32.5
SS WASHINGTON MAIL	AMERICAN	21	34.7 N	145.0 E	12	27	45	10 NM	02	999.6	10.0	17.8	3	10	27	7	19.5
MARCONA PIONEER	LIBERIAN	21	26.0 N	138.0 E	12	28	42	10 NM	18	1016.5	15.0	21.0	5	6.5	28	9	11.5
SS J L HANNA	AMERICAN	21	54.6 N	232.9 W	18	12	30	.25 NM	07	1001.5	3.9	8.9	11	11.5	18	8	8
SS HILLYER BROWN	AMERICAN	21	48.7 N	135.3 W	12	18	45	5 NM	81	1000.0	7.8	7.2	4	19.5			
SS PRES HARRISON	AMERICAN	21	37.7 N	165.1 W	18	31	45	10 NM	01	1005.8	6.7	11.1	4	10	31	6	19.5
MV KASHU MARU	JAPANESE	21	38.0 N	144.6 W	18	21	M 42	1 NM		1004.0	18.0	14.0	7	14.5	19	12	23
SS PRES TAFT	AMERICAN	22	34.1 N	153.2 E	18	25	50	10 NM	02	989.5	12.8	15.5	5	29.5			
MV PLUVIUS	GERMAN	22	36.6 N	165.6 W	00	32	41	10 NM	25	1012.2	9.0	14.2	3	11.5	32	< 6	14.5
SS PRES JEFFERSON	AMERICAN	22	33.0 N	138.2 E	00	30	45	5 NM	02	1009.1	6.1	18.9	5	13			
MV SHING ON	PANAMANIAN	22	31.2 N	152.1 E	12	25	M 43	5 NM	01	999.0	14.0	18.0	8	6.5	16	8	14.5
MV ROBERTS BANK	LIBERIAN	22	33.9 N	155.9 E	12	27	45	2 NM	16	994.7	12.5	15.5	5	11.5	27	7	18
SS CITRUS PACKER	AMERICAN	22	33.8 N	142.5 E	12	31	40	5 NM	27	1005.1	7.8	16.7	6	13	31	6	32.5
SS WASHINGTON MAIL	AMERICAN	22	35.6 N	150.5 E	00	27	45	10 NM	02	999.2	10.0	17.2	3	10	27	7	19.5
MARCONA PIONEER	LIBERIAN	22	29.9 N	136.6 E	12	29	47	10 NM	25	1015.5	9.0	18.0	6	8	29	9	13
SS J L HANNA	AMERICAN	22	55.5 N	134.9 W	00	12	55	.25 NM	07	988.2	4.4	5.6	6	11.5	17	>13	24.5
SS MOBILE	AMERICAN	22	52.7 N	133.1 W	00	16	50	1 NM	65	1001.4	7.2	6.1	12	16.5			
MV MONTIGNY	LIBERIAN	22	41.2 N	146.7 E	12	36	M 44	10 NM	03	1002.2	- 1.2	4.0	7	11.5			
MV ASIA BRAVERY	LIBERIAN	23	34.5 N	172.4 E	18	25	M 41	2 NM		997.5	16.5	17.0			25	8	16.5
MV NORDLAND	SWEDISH	23	31.6 N	154.0 E	06	27	45	5 NM	82	1002.5		18.0					
SS PRES TAFT	AMERICAN	23	34.2 N	152.7 E	00	27	45	5 NM	02	996.2	14.4	15.5	5	29.5			
MV PLUTOS	GERMAN	23	33.5 N	160.9 E	12	26	45	2 NM	13	999.0	14.0				27	X	26
SS PORTLAND	AMERICAN	23	56.5 N	142.6 W	00	11	45	10 NM	02	996.9	3.0	4.5	4	10	28	6	11.5
SS SEALAND COMMERCE	AMERICAN	23	33.2 N	153.7 E	00	27	36	10 NM	02	994.5	13.9	15.0	5	10	27	8	19.5
MV BELMAR	NORWEGIAN	25	52.7 N	141.9 W	18	11	43	.25 NM	05	986.0	6.7	1.0					
SS WASHINGTON MAIL	AMERICAN	25	41.3 N	178.0 E	00	27	45	10 NM	02	1006.5	8.8	10.6	5	11.5	27	6	16.5
MV PLUTOS	GERMAN	25	33.5 N	144.1 E	18	24	44	5 NM	02	1006.0	16.0	15.6	4	5	25	9	14.5
MV ASIA BRAVERY	LIBERIAN	26	34.7 N	157.3 E	18	27	M 41	10 NM	01	1003.0	11.0	14.0			27	8	24.5
MV ROBERTS BANK	LIBERIAN	26	37.6 N	176.8 W	12	31	49	10 NM	27	1014.7	7.5	11.0	6	10	30	6	13
MV ASIA BRAVERY	LIBERIAN	28	34.6 N	151.9 E	00	20	M 45	2 NM	80	1003.5	14.0	17.0			28	8	16.5
SS HAWAII	AMERICAN	28	34.8 N	142.4 W	12	27	45	2 NM	82	1000.7	12.8	16.7		28			
SS THOMAS E CUFFE	AMERICAN	28	36.5 N	141.0 W	18	30	45	2 NM	64	997.4	11.7	15.6			30	12	26

+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: The observations are selected from those with winds ≥ 35 kt or waves ≥ 25 ft from May through August (≥ 41 kt or ≥ 33 ft, September through April). In cases where a ship reported more than one observation a day with such values, the one with the highest wind speed was selected.

Rough Log, North Atlantic Weather

April and May 1975

ROUGH LOG, APRIL 1975--It appears that the place to start the discussion of the marine climate for this month is with the mean pressure pattern. According to climatology, the 1007.5-mb Icelandic Low is centered near Kap Farvel. The overall pattern is a gourd shape extending into the Norwegian Sea, with a minor Low in that area. This month, that pattern was shifted 1,100 mi to the southwest. The main Low (1008 mb) was centered near Sydney, Nova Scotia, with the same shape extending northeastward with two minor Lows, the northern one being about 200 mi east of Kap Farvel. The mid-Atlantic High, at 1026 mb, was shifted northeastward to near 43°N, 22°W, from its 30°N, 40°W, climatic position at 1021 mb. The High that is normally north of the Queen Elizabeth Islands was shifted southward to northern Hudson Bay, at 1028 mb. These shifts resulted in large anomalies, which will be discussed later.

Without getting into the argument of which came first, the chicken or the egg--whether the pressure pattern is a result of the storm tracks or vice versa--the storm tracks were also misplaced, although not as much as the pressure pattern would indicate. The Hudson Bay, Davis Strait, and Baffin Bay area was almost devoid of storms. The LOWs originated over the central United States rather than being evenly divided between there and central Canada. Many of these were diverted southward over the New England States, rather than along the St. Lawrence River. Storms off the U.S. east coast tended to form farther out at sea and moved more eastward, prior to turning northward toward Iceland, and then into the Norwegian Sea. No storms tracked across southern England, nor out of the Bay of Biscay into the Mediterranean Sea, as is usual.

As would be expected from the previous discussion, there were several large, important anomaly centers, three positive and one negative. The negative, a minus 5-mb, was centered near 40°N, 60°W. From west to east, the positive centers were an 11-mb over northern Hudson Bay, an 8-mb over central Greenland, and a 9-mb near 45°N, 25°W.

In the upper air, the Polar Low was nearly normally located, with the pressure surfaces slightly lower. Normally a trough exists down Baffin Bay and along the U. S. east coast. This month, the trough was accentuated, and a LOW was centered over the Gulf of St. Lawrence. This resulted in a much tighter gradient over the western ocean. The ridge normally over western Europe was greatly accentuated and farther west, near 20°W. The anomaly patterns closely paralleled those at sea level except over Green-

land, where the sign was reversed.

There were no tropical cyclones, and none would be expected, as there is no record of any as far back as 1886.

Extratropical Cyclones--Monster of the Month--The first significant storm of the month originated over the Texas-Oklahoma border on the 2d. It deepened very rapidly as it moved up the Ohio River Valley. On the 3d, at 1200, it was 980 mb over Buffalo, N.Y., and southeasterly gales were blowing off the East Coast. Twelve hours later, it was 972 mb near Boston. The USCGC TANEY was near 37.5°N, 72°W, with 45-kn gales and 20-ft seas out of the west. Three other ships reported 40-kn gales east and southeast of Hatteras. The CARBIDE TEXAS CITY, at 32°N, 72°W, came in with 50-kn winds. Northeast of the center, the HUDSON, off lower Nova Scotia, was also battered by 50-kn winds. The COLON BROWN (15,471 tons) returned to Halifax Harbor, on the 3d, and grounded on Lighthouse Bank during high winds. Two barges sank at Newport News.

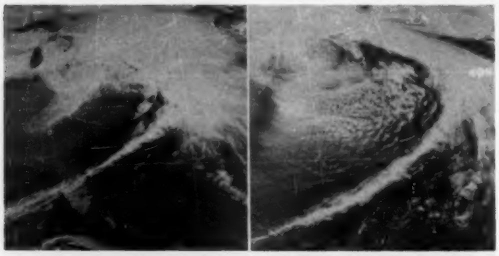

Figure 49.--These two satellite images 24 hr apart, at 1700 on April 3 and 4, show the monster storm as it moved off the U.S. east coast and attacked the SPARTAN LADY.

The 13,322-ton Liberian tanker SPARTAN LADY broke in half, while about 120 mi southeast of Montauk Point, N.Y., in heavy seas on the 4th (fig. 49). Ships in the vicinity, including the OROTAVA, PHILINE, and ERET, reported 23-ft seas or swells. Coast Guard helicopters rescued the crew (fig. 50), but one died, reportedly of a heart attack. The helicopter crew reported 80-kn winds in the area. The stern section sank, but the bow section had to be sunk by the Coast Guard.

At 1200 on the 4th, there were many 40- and 45-kn winds. The TANEY again reported 50-kn winds, as

Figure 50.--Crewmembers on the stern of the SPARTAN LADY await rescue by U.S. Coast Guard helicopters. U.S. Coast Guard Photo.

she headed toward Norfolk. The KASTAN reported 60-kn winds near 32°N, 67°W, near the same relative position, but farther east, where earlier the CARBIDE TEXAS CITY had reported 50-kn winds. Seas and swells of 15 to 23 ft were being reported. At 0000 on the 5th, the EXXON BANGOR was headed northward off Cape Charles with 50-kn winds and 36-ft swells. Nearby, the BAYANO appeared to be headed into Delaware Bay with 45-kn northwesterlies on her starboard side. The AUSTRAL ENTENTE put into Charleston, S.C., because of shifted cargo.

This was the worst storm of this winter-spring season for the U.S. east coast. Snow, floods, and high winds paralyzed many areas. Drifts as high as 5 ft were reported in northern New England. Many thousands of homes were without electricity. Airports were closed; National at Washington, D.C., measured gusts to 57 kn. The northwest winds resulted in the lowest water levels on Chesapeake Bay and the Potomac River since 1908.

On the 5th, the LOW, at 986 mb, had split into double centers. Gales were still blowing in the southwest quadrant. The PHILINE (35°N, 67.5°W) estimated only 40-kn winds, but 20-ft seas and 39-ft swells must have been hard to mistake.

By 0000 on the 6th, the LOW once again had a single center, and its circulation extended eastward to 35°W, and from 24° to 57°N. The reported winds had decreased to a minor 35 kn. The LOW was now headed northward and filling. It moved over the Gulf of St. Lawrence on the 8th, and dissipated on the 9th.

A frontal wave formed in an area of weak gradient off the Carolina coast, late on the 10th. It quickly wound up and, by 0000 on the 13th, was a small 990-mb storm rolling northeastward. The SOYO MARU was due south of the center (41°N, 53°W), near 37.5°N, 53°W, with 45-kn gales. The storm continued racing northeastward with only slight deepening. At 1200 on the 14th, the 982-mb LOW was at 53°N, 28°W. The SCHIROKKO was fighting 55-kn bow winds, near 47.5°N, 27°W, with 13-ft seas and 15-ft swells, 20° off the wind. On the 15th, the storm turned eastward and then southeastward, to disappear over the continent on the 16th.

A Cape Hatteras Storm! At 1200 on the 15th, a 1001-mb LOW was directly over Cape Hatteras, having first been identified 6 hr earlier over South Carolina. The TRANSHAWAII was sailing up the coast with 40-kn winds and 20-ft waves. Twenty-four hours later, the 990-mb storm was near 38°N, 68°W, with gale-force winds in all quadrants.

By 0000 on the 17th, the central pressure had plunged to 976 mb near 39°N, 65°W, and the winds were howling. The R. G. FOLLIS was south of the center, at 36°N, being ravaged by 60-kn winds, 41-ft seas, and 46-ft swells. The ERET was practically in the center with 40-kn southerly winds and 30-ft seas. About 200 mi north of the center, the CHERNOMORSKAJA SLAVA was pounding into 50-kn winds and 20-ft seas.

The storm was moving very slowly, and its circulation expanding. Gale-force winds and high seas were the rule. The YZJE was near 36.5°N, 68°W, with 45-kn winds on her port side, which was being hammered by 41-ft seas and 49-ft swells (fig. 51).

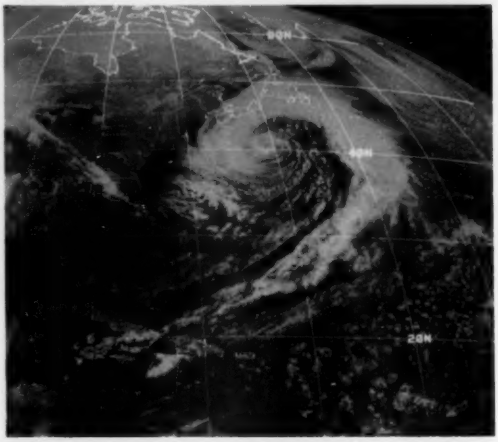

Figure 51.--The frontal cloud band is roughly 10° of longitude ahead of the easily located storm center, at 1700. The reported high winds and waves were south through west of the center.

The storm was headed toward Cape Race, which it passed at 1800 on the 18th, leaving gale-whipped ships in its path. The storm was now losing most of its punch over the cold water off the Labrador Sea and was gone by the 21st.

This LOW split off another LOW that had formed earlier over the central ocean and moved northward and then westward to Greenland. It split off early on the 18th, near 55°N, 25°W, at 978 mb. It immediately treated the RYBATSKAJA SLAVA to 40-kn winds and 16-ft seas. At 1200, Ocean Weather Station JULIETT had 40-kn gales, 28-ft seas, and 20-ft swells. A SHIP near the LOW was hammered by 50-kn winds as it sailed southwestward. The LOW, which had now filled to 996 mb, moved south of INDIA, early on the 19th, leaving two ships south of her with 40-kn memories.

It appeared that the storm was about to die out as its center moved toward and north of the Faeroe Islands, but, at 0000 on the 20th, it hit the Shetland Islands with 50-kn winds. The storm disappeared over the Greenland Sea on the 22d.

The history of this storm is slightly different from most. As in many cases, it developed as a wave on a front, but in midocean rather than near shore or over land--near 43°N, 45°W, at 0000 on the 23d. It moved rapidly northward as a wave, with little development until the 24th. At 1200, it combined with a nearly stationary LOW that was over southern Greenland and had originated over the midwestern United States many days earlier. On the 25th, the combined system moved into the Denmark Strait. This usually dooms a system, as it either dissipates or continues into the Greenland Sea. During this time, only minimum-level gale-force winds were reported.

A closed upper-air LOW was centered over southern Greenland, on the 26th, as the surface LOW made a counterclockwise loop and moved southward to 63°N. By the 27th, the upper-air system had deteriorated to a trough and was moving eastward, as was the surface LOW. It was still a very weak storm (1008 mb), but gale-force winds were now blowing south of the center.

At 0000 on the 28th, the central pressure had fallen to 990 mb, and THALASSA, near 57°N, 20°W, was battered by 45-kn winds and 26-ft seas. At the midday observation, Ocean Weather Station INDIA measured 40-kn northwesterly winds and was mauled by 26-ft seas and 30-ft swells. The ASIA FREIGHTER, 400 mi south at 53°N, 21°W, also had 40-kn gales, but the waves were not nearly as high.

At 1200 on the 29th, the 976-mb LOW was south of the Faeroe Islands and about to turn north- and then westward again. At that time, the MULAFOSS was midway between Iceland and the Faeroe Islands, with biting 1°C, 60-kn storm winds. To the south, 40- and 45-kn winds were observed. The OTHELLO was off the northeastern coast of Iceland, on the 30th, with 45-kn gales of -5°C.

The center of the LOW brushed the southeast coast of Iceland, on the 30th, with gale winds at coastal stations. It turned eastward again, on May 1, to visit OWS INDIA again with 35-kn gales and waves to 20 ft. This time the LOW continued east-northeastward over northern Scandinavia.

This last storm of the month didn't really develop until May. The western ocean off the U. S. east coast was an area of flat pressure gradient between two large HIGHs. A weak 1011-mb LOW was indicated, on the 29th, by widely spaced ship reports. It drifted eastward, with indications of three weak centers, on the 30th. By May 1, the Bermuda High had moved westward, and two low centers were well defined by the circulation and ship reports. By this time, the primary center had dropped to 992 mb, and gale winds were being reported. At 1200, the TRENTWOOD, at 45°N, 52.5°W, was headed into howling 45-kn gales. The AMERICAN ALLIANCE, at 42°N, 56°W, had 40-kn winds on her starboard side and was being battered by 20-ft seas and 25-ft swells.

At 1200 on the 2d, the SKAFTAFELL was just off Cape Race with 50-kn winds, as the 984-mb LOW made a loop over the Grand Banks. Winds of 35 and 40 kn were reported southwest and east of the center. On the 3d, the MANCHESTER ZEAL, at 42°N, 54°W, was rocked by 25-ft swells on her port side. Farther

north off Cape Race, a ship had 26-ft seas. On the 4th and 5th, the LOW traveled due north along the 37° meridian to the King Frederik Kyst, where it again circled. At 1200 of the 5th, a ship radioed a 55-kn observation near 61°N, 24°W, with 26-ft seas. The LOW weakened on the 6th and 7th, as it continued to pound the Greenland coast.

Casualties--The Italian motorvessel ATREO (8,687 tons) was taken to Halifax by the tug POINTE MARGUERITE, after being disabled in ice in Cabot Strait on the 3d. The 9,244-ton British-registered CARREL reported being icebound, about 50 mi west of Newfoundland, on the 7th.

The oil-prospecting ship COMPASS ROSE III disappeared north of Scotland, with a crew of 16. British rescue ships and aircraft made a massive search without finding them.

ROUGH LOG, MAY 1975--May is generally a confused month for storm tracks, and this one was no exception. Climatically, the storm tracks from the west, the southwest, and off the U.S. east coast converge over the Gulf of St. Lawrence and then diverge into the Labrador Sea and toward the Faeroe Islands. This month, they converged south of Nova Scotia--the gross coordinates were 39°N, 63°W. From that point, the track was eastward, and then northward along 40°W, to the west coast of Greenland. Two storms made the grand tour to the continent--one to France and the other to England. There was a minor track across Spain and the northern Mediterranean.

According to the climatological mean sea-level pressure charts, the Icelandic or North Atlantic Low is a weak area between the Bermuda-Azores High and a polar High. The point of lowest mean pressure is near 57°N, 37°W, at 1012.3 mb. This month, the closed 1007-mb center was near 51°N, 44°W. The two Highs were present and nearly encircled the Low. A ridge of the Bermuda-Azores High extended northward west of the continent, with a 1020 isobar joining the polar High. There were two 1024-mb centers, one at 33°N, 28°W (versus 1022 mb at 30°N, 40°W, the climatological center) and the other at 59°N, 10°W, with no climatological counterpart. A ridge from the polar High extended southward across northeastern Canada as far south as the north shore of the Gulf of St. Lawrence. This left the only entrance to the Icelandic Low along and off the East Coast, and this was the path the storms took.

The anomaly pattern had several major centers, only one of which was negative. That center was minus 6 mb, centered near 49°N, 43°W. The major positive centers were a 5-mb near the Canary Islands, a 10-mb near 59°N, 12°W, an 8-mb over central Greenland, and a 5-mb over northern Labrador.

In the upper air (700 mb), the long-wave pattern was nearly normally placed, but the troughs and ridges were much sharper than the climatological pattern indicates. This produced positive anomalies over the North American east coast, negative over the western ocean, and positive over the northeastern ocean.

There were no tropical cyclones this month. On an average, only one occurs each 5 yr.

Extratropical Cyclones--A front stretched east-west along the Gulf Coast on the 8th. At 1200, a wave was analyzed off Savannah, Ga. For approximately the first 30 hr, it was stable and slowly moved eastward. By the 0000 chart of the 10th, it had become unstable and was deepening and developing a compact circulation. At 1200, the EXXON HUNTINGTON, off Wilmington, N.C., had 35-kn winds and squalls in sight. At 1200 on the 11th, the 1004-mb LOW was near 39°N, 63°W. The AMERICAN ALLIANCE (37°N, 59°W) was east of the cold front in the warm sector, and reported only 15-kn winds with 10-ft seas from 230°, but 46-ft swells from 200° (fig. 52).

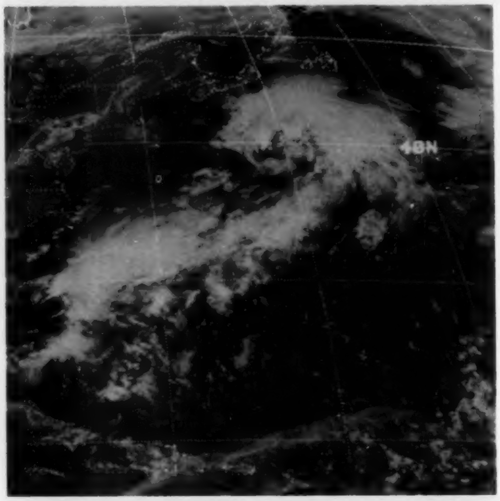

Figure 52.--At 1700 on the 11th, the center of the LOW is near 40°N, 60°W. The AMERICAN ALLIANCE's 1200 position is now west of the cold front.

The center of the LOW moved over Cape Race, about 1400 on the 12th. Twelve hours later, the HUDSON was 300 mi south of the center with 35-kn gales. On the 14th, the LOW passed between OWS JULIETT and OWS KILO with only breezes. Late on the 16th, it moved inland over the west coast of France.

This storm originated over Louisiana on the 14th. It crossed the New Jersey coast, about 1000 on the 16th, still a 1010-mb wave. Rapid changes in the upper air were taking place on the 17th and 18th, as the surface storm raced eastward. There was no one main center during this time, but several centers of the same pressure. On the 18th at 1200, there was a 976-mb center near 48°N, 45°W. The circulation had expanded and deepened greatly as the storm came under the main upper-air LOW. The EWAE was at 45.7°N, 51.9°W, with 55-kn northwesterly winds and 12-ft seas. The AGAMEMNON and CETRA COLUMBA, in the southwest quadrant, had 40-kn gales. Many miles to the east, ahead of the occlusion, two ships reported 35-kn southerlies.

At 0000 on the 19th, the BORKUM was about 250 mi south of the center, with 50-kn westerlies and 39-ft seas on her starboard side (fig. 53). The KOHNAN

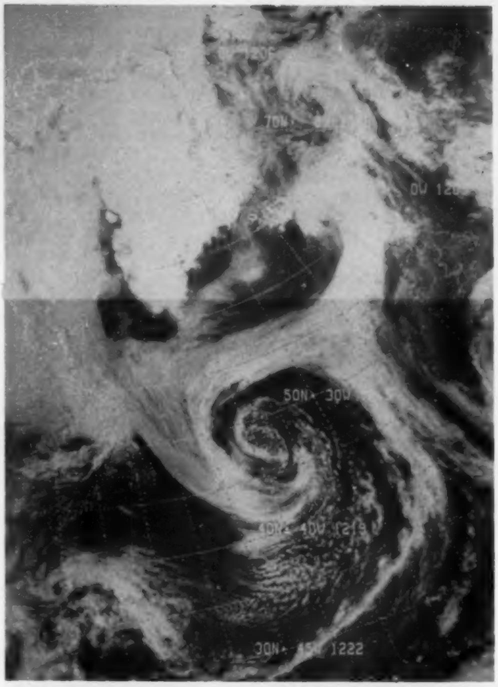

Figure 53.--This storm presents an unusual cloud pattern. Two low centers are east of Greenland. The frontal occlusion is near 50°N, 27°W, with the occluded front oriented westward from that point.

MARU (41.5°N, 49°W) had 40-kn gales, while the SHURA KOBER (42.5°N, 46°W) had 30-kn gales with 26-ft seas.

Gale-force winds continued to blow as the surface center meandered under the upper-air LOW. At 0000 on the 20th, the LEVERKUSEN had 45-kn winds, and the ATLANTIC CHAMPAGNE had 40-kn winds and 23-ft swells, near 43.5°N, 41.5°W.

At 1200 on the 22d, the low-pressure area resembled a four-lobe cam, with four separate centers (fig. 54). Twenty-four hours later, there were still three centers. A center which developed south of Kap Farvel, on the 22d, was to become the primary circulation, as the original LOW weakened and raced through the Denmark Strait, and into the Norwegian Sea.

A very minor wave was analyzed, on the 1200 chart of the 27th, off the New England coast, south of the Bay of Fundy. It moved slowly eastward, gradually deepening and increasing its area of influence.

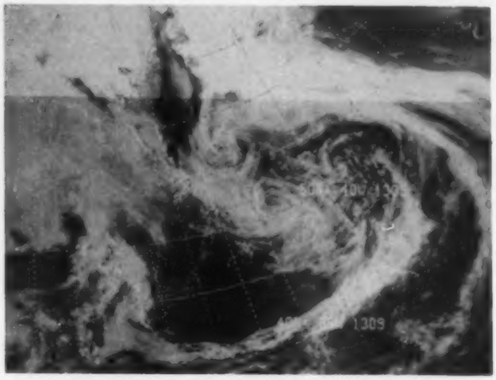

Figure 54.--Three of the low centers are easily identifiable (58°N, 50°W; 51°N, 48°W; 51°N, 37°W). The fourth is near 57°N, 37°W.

By 1200 on the 30th, the 988-mb LOW was near 47°N, 46°W. There were gale-force reports around the storm, and maximum seas of 16 ft. On the 31st, an upper-air LOW was centered near 48°N, 48°W, and the center of the surface LOW looped counterclockwise under its cyclonic circulation. The pressure gradient remained relatively weak, with no strong winds.

The surface LOW remained directly associated with the upper-air LOW, as it drifted southeastward. On June 3, a deepening trend started. At 1200 on the 4th, a ship reported 40-kn winds northwest of the 982-mb center. Early on the 5th, 35- to 40-kn gales were blowing over the western half of the circulation. At 1200, the GOLDEN ORCHID report was received, with 55-kn winds near 46.5°N, 19.5°W. Compared with other wind reports in the area, this appeared too high, until the wave report was considered. The seas were 38 ft, and the swells, 23 ft. The sky was coded as obscured. The LOW moved northward on the 6th and 7th, losing its upper-air support, and dissipated south of Iceland.

Casualties--The 21,607-ton Norwegian tanker PERIKUM ran aground in heavy rain, at Mile 37 in the Orinoco River. On the evening of the 29th, the 32,306-ton American DELTA MAR and the 24,424-ton Liberian ALKES collided about 90 mi southeast of Port Arthur, Tex., during a thunderstorm.

Rough Log, North Pacific Weather

April and May 1975

ROUGH LOG, APRIL 1975--The storms this month, in general, were not as severe or intense as usual, although they were above normal in number. The primary tracks were displaced somewhat, especially over the west central ocean. The primary tracks from off the Asian continent and from south of Japan had a more easterly, than the climatic northeasterly, direction. Near longitude 165°E, the tracks turned north-northeastward and northeastward--the northern ones into the western half of the Bering Sea, and the southern ones to parallel the Aleutian Islands and into Alaska and the Gulf of Alaska. The broad expanse of ocean between Hawaii and the U. S. coast was almost devoid of cyclone centers.

The mean sea-level pressure analysis reflected the storm tracks. The large ocean area approximately bounded by the Bering Strait, North American west coast, 20°N, and 160°E, was above normal in pressure. The western ocean west of 160°E was near normal, or slightly below normal. There were three low centers across the northern ocean, all 1010 mb, versus the 1009-mb climatic value. The Pacific High, normally about 1023 mb, was 1030 mb and centered farther east, near 35°N, 145°W.

The most significant anomaly was a positive 11-mb centered near 45°N, 145°W. A less significant anomaly was a positive 3-mb over Sakhalin Island. Although not large, it was definitely reflected in the storm tracks out of Asia.

The upper-air pattern resembled climatology, only shifted. The primary low center was over the Sea of Okhotsk, rather than the central Bering Sea, but the trough was shifted eastward off the coast of Japan, rather than along the continental coast. There was a stronger ridge than normal off the U. S. west coast, and it was closer to the coast by about 10° of longitude.

There were no tropical storms this month.

<u>Extratropical Cyclones</u>--The first storm of the month formed over the Chinese mainland, on the 4th, and raced across the Yellow Sea and the Sea of Japan, and into the Sea of Okhotsk on the 6th.

This storm wreaked havoc over Japan (fig. 55). Winds of 40 kn swept through the archipelago on the 5th and 6th. Five vessels were capsized in rough seas, killing four persons; another four were missing. Two more persons were killed as the result of strong winds. Two freighters ran aground near Kobe Port because of high winds. They were the 9,249-ton ATLANTIC NEPTUNE and the 1,595-ton MINILILAC. Another freighter, the 8,397-ton ADELINA, was pushed aground near Onahama Port. Helicopters took off all 39 crewmen because the vessel was flooded to a dangerous level. The TAIKO MARU capsized off Wakayama Prefecture, with only two of seven crewmen rescued. In the same area, the 7,894-ton ORIENT STAR went aground.

On the 6th, a coastal station on the Tatar Strait had a 40-kn norther. At 1200, the 980-mb storm was centered over the Kuril Basin, and another coastal station, on the west coast of Kamchatka, was warmed by

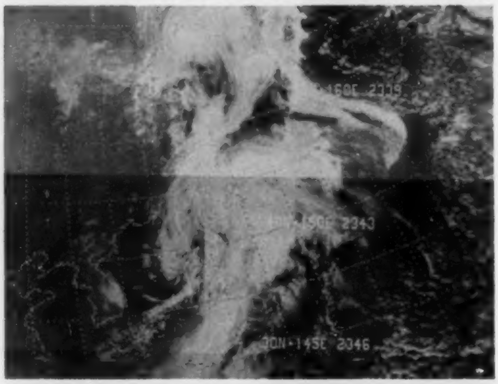

Figure 55.--Appearances can be deceptive. The cloud pattern does not indicate a well-organized storm, but hidden beneath the clouds were destructive winds.

40-kn southerly winds. On the 7th, a ship which may have been the BIZON fought 45-kn winds and 23-ft seas on the Sea of Okhotsk.

As the storm center moved northward over the cold water and ice, it started to fill, and no longer existed on the 8th.

An almost stationary cold front had been pushing against a stubborn HIGH, located between Hawaii and Alaska, for several days. Frontal waves had been developing on the front, but none gained notoriety. On the 5th, another developed near 30°N, 178°E. It moved northeastward between two 1032-mb HIGHs. On the 5th and 6th, no gale-force winds were reported, but, by 0000 on the 7th, the 990-mb storm was near 42°N, 171°W, and one of the highest winds of the month was observed. A SHIP, near 38°N, 174°W, was battered by 60-kn northerly winds driving 33-ft seas and swells. The VOSGES, northwest of the center at 42.5°N, 174°W, had 45-kn portside winds. Many ships, 300 to 400 mi south of the center, had gales with 15- to 20-ft waves. Early on the 8th, the SANTA CATALINA MARU was in the northwest quadrant with 50-kn winds and 20-ft swells. The VOSGES was now fighting 25-ft seas. On the 9th, the highest winds radioed to METEO were 35 kn, but there were several reports of 26-ft swells, and more of 20 ft. On the 11th, the LOW was in the Gulf of Alaska, but it had lost its punch battling the high pressure.

This was one of the longer-lived storms of the month. It originated on the 8th over Mongolia, and dissipated over Alaska on the 16th. On the 10th, it moved over the Sea of Japan, not yet a severe storm.

The first gales were reported on the 12th, when the 988-mb LOW was near 44°N, 152°E. Early on the

12th, the HOTAKA MARU was off the Kuril Islands, with 45-kn northwesterlies. There were 35-kn gales up to 600 mi south and southeast of the center. On the 12th and 13th, the AKAISHI MARU, CURACO MARU, and WAKANESAN MARU all reported gales. About 0100 on the 13th, the 976-mb center passed directly over the Near Islands. At 1200, the OHMINESAN MARU, north of Unimak Island, had chilling 45-kn southerly winds, with 13-ft seas and 16-ft swells.

Late on the 14th, the LOW moved over the Bering Sea ice field and began to fill rapidly. It was still a small circulation as it moved into western Alaska and disappeared on the 16th.

This low center more or less just came into being over the Gulf of Alaska. It had no real track, as it remained quasi-stationary over the northern Gulf. On the 16th and 17th, there were several minor troughs and LOWs in the area, and two small LOWs moved in from the southwest. These all gradually combined into a double-centered LOW, on the 17th. On the 18th, the PHILADELPHIA, at 57°N, 144°W, found 35-kn gales and 16-ft swells. The ALASKA MARU was sailing into 45-kn gales and 20-ft swells, near 52°N, 148°W, on the 19th. The ESSO NEWARK was headed into the Gulf, near 51°N, 138°W, with 35-kn port winds. By the 20th, the center was little more than a weak area in the isobars off Juneau.

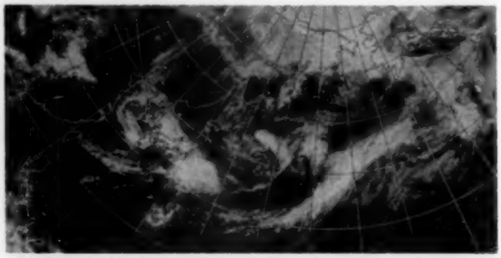

Figure 56.--Only three of the eight cyclonic circulations are easily identifiable on this small-scale composite made from orbits late on the 20th.

At midday on the 20th, there were eight cyclonic circulations of various strengths analyzed on the chart between 170°E and the Asian mainland (fig. 56). One of these, near 41°N, 163°E, was destined to produce high waves. As usual, the LOW tracked northeastward and, at 0000 on the 22d, was near 51°N, 178°E, at 998 mb. East of the center, at 49°N, 175°W, the GYOKUYO MARU was steaming into 35-kn gales from the southeast. The seas were running at 31 ft, with interspersed 16-ft swells. Twenty-four hours later, the 990-mb LOW was south of the Alaska Peninsula. The VINGNES, south of Amlia Island, found 40-kn gales. About 300 mi south of the center, the TOWER BRIDGE was headed into 35-kn westerlies, 20-ft seas, and 25-ft swells.

The storm continued eastward across the Gulf of Alaska and passed inland over Vancouver Island, late on the 24th.

The East China Sea was the whelping ground of this LOW, on the 19th. It moved along the southern coast of Japan on the 20th and 21st. At 0000 on the 22d, the 1000-mb LOW was at 35°N, 150°E, with the tightest gradient on the eastern side of the circulation. The TOYOTA MARU was in the warm sector, southeast of the center. She observed only 30-kn winds with 10-ft seas, but the swells were 23 ft.

The LOW turned northeastward and slowly intensified in pressure, but it was not until the 24th that the circulation expanded. Early on the 24th, the BAY BRIDGE encountered 40-kn winds in the southwest quadrant. At 0600, the center crossed into the Bering Sea. At 0000 on the 25th, the 962-mb LOW was at 57°N, 167°W, and the HAKUZAN MARU was at 53°N, 164°W, south of the islands, and sailing eastward with 55-kn winds. The swells were 31 ft. Twelve hours later, the OHMINESAN MARU (at 56°N, 166°W) was chilled by 45-kn northwesterlies blowing moderate snow. The dry-bulb temperature was -1°C. The ALASKA STANDARD had 45-kn winds from the southeast in Cook Inlet.

At 0000 on the 26th, the PACPRINCESS, at 53°N, 156°W, was battering into 33-ft swells and 40-kn westerly winds. The LOW had moved inland over Cape Newenham, and the rugged terrain was tearing it apart.

Casualties--Two ships collided in dense fog off Onahama Port, on the 15th. They were the 999-ton OTE MARU and the 15,053-ton KING JU. Fog was again the culprit, on the 27th, when the STAR BILLABONG and the YAMATO MARU collided in Tokyo Bay.

High winds and waves can be jarring, but collisions in fog are more so. On the 29th, the fog was over Osaka Bay, where the 4,694-ton ferry KATSURA and the 3,967-ton container ship SANSHIN STAR collided. Only 10 of the 409 passengers on the ferry suffered injuries. No crewmen on either ship were hurt. The next day, on the 30th (fig. 57), the 378-ton freighter SHORYU MARU and the 9,084-ton KOSTANITIS YEMELOS tried to occupy the same space on Tokyo Bay,

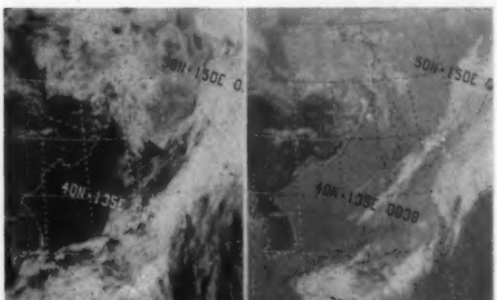

Figure 57.--By comparing these two simultaneous images--visual and infrared--the fog and low stratus can be differentiated from the high, cold clouds. The fog shows only faintly on the infrared (right), as its temperature is nearly the same as the surrounding surface.

while fogged in.

An unexplained 25-ft wave roared down Douglas Channel, in British Columbia, and caused extensive damage at the village of Kitimat. A similar wave occurred last fall.

ROUGH LOG, MAY 1975--The paths the storms traversed this month followed the climatological pattern. The number was above normal, and the pressures generally deeper. The majority originated south of Japan, traveled northeastward to the Aleutian Islands, and paralleled them into the Gulf of Alaska. During the latter part of the month, the storms tended to originate and track farther south across the mid-ocean. There also were more individual cyclones the last half of the month.

The main feature of the mean sea-level pressure pattern was the Pacific High. It was normally located, with two centers, the eastern-most one being about 3 mb higher in pressure than normal, with a sharper ridge extending farther up the North American west coast. The Aleutian Low was about 3.5 mb lower in pressure and centered much farther east than normal, south of the Shumagin Islands rather than north of the Near Islands. There was an anomalous High over the Sea of Okhotsk, which is normally under the influence of the Aleutian Low.

The primary negative anomaly center was 7 mb and colocated with the misplaced Aleutian Low. A large area of slightly negative values was located between 20° and 30°N, from south of Japan to 165°E. The High over the Sea of Okhotsk produced a positive 7-mb anomaly. The higher pressure of the eastern part of the Pacific High, plus the more intense ridging northward, resulted in a positive 5-mb anomaly center off the California coast.

The primary difference between climatology and the monthly mean 700-mb height pattern was in the location of the centers. Both the LOWs and HIGHs were shifted eastward from their climatic positions. Their central values were also lower and higher, respectively. The primary wind flow was zonal, with a short-wave trough off the Japanese coast and a ridge over the North American west coast.

There were no tropical cyclones this month. The averages show one can be expected each 2 yr in the eastern ocean, and three every 2 yr in the western ocean.

Extratropical Cyclones--Monster of the Month--The first significant storm of this month developed east of Hokkaido and south of Ostrov Simushir, on the 5th. It moved east-northeastward as an oval circulation, as it pushed against a HIGH over the central ocean. It was not until 0000 on the 7th, that gale-force winds were reported. At that time, the 974-mb storm was near 51°N, 171°W. The MIDAS RHEIN, at 49.5°N, 168.3°W, was sailing into 50-kn winds and 16-ft seas. To the south, near 46°N, 166°W, the HOSOSHIMA MARU was experiencing 40-kn gales.

At 1200 on the 7th, the MONTIGNY (49°N, 167°W) was banged by 50-kn winds and 20-ft seas and swells on her port side. The PHILIPPINE MAIL (46°N, 166°W) had 45 kn on her stern, with 23-ft swells. Further around the circulation, the CHINA BEAR (44°N, 161°W) was racing at 20 kn, with 40-kn winds and 18-ft seas and swells.

At 0000 on the 8th, the 968-mb LOW was near 50°N, 151°W. The winds had picked up to 55 kn for the CHINA BEAR, which was now at 44°N, 156°W. The seas and swells were 25 ft. The AMERICAN LYNX was on the southwest perimeter of the circulation, with 40-kn winds and 28-ft seas. Gales of 40 kn were blowing in all quadrants. At 1200, two ships reporting these winds were the PHILADELPHIA and the PORTLAND. At 0000 on the 9th, the LOW was slightly south of OWS PAPA, at 982 mb (fig. 58). The HARBOUR BRIDGE was at 50°N, 137°W, with 34-ft swells from the southeast. Waves of 20 to 25 ft were a common sight in the southern half of the storm.

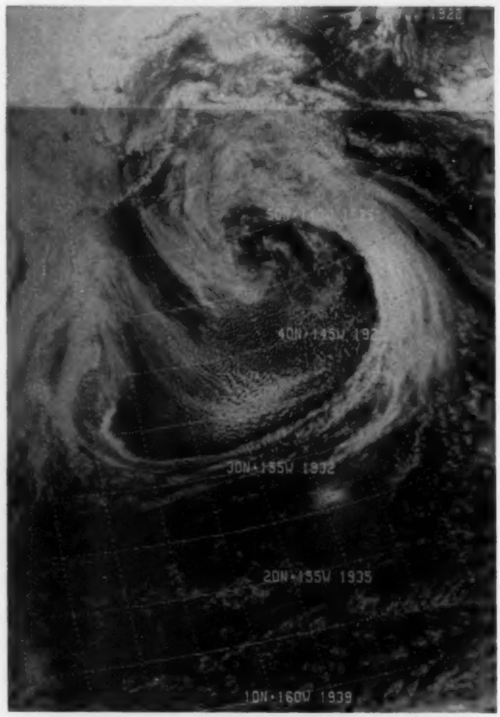

Figure 58.--At 1925 on the 8th, the low center is slightly west of Ocean Weather Station PAPA. The cloud streaks parallel the basic wind flow.

On the 8th, the storm had turned southeastward. On this track, it was gradually weakening, as it and a branch of the Pacific High gradually eroded each other.

This LOW formed in the wake of the previous storm, on the 7th, near 44°N, 158°E. It moved over the Near Islands, about 1800 on the 8th, at 985 mb. As the center neared latitude 55°N, it turned eastward. At 1200 on the 10th, the DAIAN MARU was south of the Rat Islands with 40-kn gales, 13-ft seas, and 20-ft swells. At 0000 on the 11th, the BRITISH PATIENCE, south of Tanaga Island, recorded 45-kn gales, with 26-ft seas and swells.

After the LOW entered the Gulf of Alsaka, the pressure started to rise. The BAY BRIDGE was about 200 mi south of the center, with 40-kn winds. Eight hundred miles southeast of the center (44°N, 137.5°W), the ZENLIN GLORY was sailing into a 50-kn storm.

Late on the 11th, the LOW turned southward; on the 13th, it curved back toward the north; and dissipated on the 14th.

This storm came out of the East China Sea on the 9th. It raced eastward south of Japan, until turning northeastward on the 10th. At 0000 on the 11th, the IBERVILLE was near 36°N, 157.5°E, and about to cross the cold front westbound. The winds were 40 kn, with 12-ft waves. Late on the 11th, the storm turned northward in response to another surface LOW over Mys Loptaka, and the upper-air LOW. The two surface systems combined, on the 12th, and again turned eastward. At 0000, a ship reported 40-kn gales south of the center, at 41°N. The winds were still minimal gales, but the seas were building to 20 ft, on the 13th. At 0000 on the 14th, the 984-mb LOW was near 52°N, 179°E, and moving southeastward to cross the Aleutians southbound. The SUSONG was far to the south of the center, near 44°N, 173°E, with 30-ft seas and 36-ft swells from the west on her starboard bow. On the 15th, the WASHINGTON reported 35-kn gales and 20-ft waves.

As the storm moved toward the Gulf of Alaska, it deteriorated rapidly and disappeared from the analysis, near Sitka, on the 18th.

This cyclone had extreme longevity, existing for 17 days over the Pacific. The storm came out of the Yellow Sea, on the 13th, and slowly tracked south of Japan. It took 4 days to make the voyage and develop into a significant LOW. On the 18th, it had a 990-mb center near 38°N, 150°E. The PACIFIC ARROW was near 36.5°N, 148°E, with 40-kn winds. Another ship northeast of the center had 35-kn gales. On the 19th, the DAISHAN MARU and OGDEN AMAZON had 40- and 45-kn gales, respectively, north of the center.

As the storm moved southeastward, it weakened, and it appeared that it might dissipate, but, on the 21st, it swung northeastward and again intensified. At 0000 on the 22d, the BLUE SKY was northwest of the center, with 45-kn winds and 16-ft waves. Southwest of the center, the PLUVIUS had 40-kn winds, with 16-ft seas and 26-ft swells.

On the 23d, a HIGH, which had been centered northwest of the LOW's center, squeezed north of the cyclone to join a HIGH off the California coast (fig. 59). This slowed the LOW's movement nearly to a standstill. After passage of the HIGH, the LOW raced northward. The J.H. TUTTLE was near 52°N, 150°W, with 45-kn winds, and OWS PAPA had 40 kn, with high seas.

On the 25th, as the storm appeared ready to enter the Gulf of Alaska, it changed course toward the northwest. The CHEVRON HAWAII reported departing Cook Inlet with 50-kn winds on her port side. On the 26th, the storm stalled near Unimak Island, and finally dissipated on the 29th.

This was the third of three severe storms that were generated in this area: one each 5 days--8th, 13th, and 18th. As with the others, this LOW traveled south of Japan and, by 1200 on the 20th, was 973 mb at 41°N, 151°E. The LOTUS was washed by heavy rain and 35-kn winds, about 100 mi northeast of the center. At 0000 on the 21st, the EASTERN BUILDER, near 42°N, 152°E, was headed directly into 50-kn winds, 13-ft seas, and 25-ft swells, as she passed slightly east of the center. Gales were blowing all around the center. A ship was plotted near the occlusion as 70 kn, but the seas indicated this was probably a transmission error.

On the 22d, the YAMATADA MARU was sailing

Figure 59.--About 1850 on the 22d, the LOW is near 40°N, 160°W. Another LOW is near the British Columbia coast. The HIGH is between these two systems and the Aleutians.

northeastward, near 43°N, 153°E, with 30-kn winds on her port side, and being pounded by 21-ft seas and 31-ft swells. To the east, at 41°N, 160°E, the DAISHOWA VENTURE was sailing into 35-kn winds, with 23-ft swells. Twelve hours later, the YAMATADA had moved only about 100 mi and still had 20-ft seas and 30-ft swells.

The LOW moved south of the Aleutian Islands with a central pressure around 996 mb. The pressure gradient was comparatively weak, with only a few minimal gales reported. On the 25th, it was tracking southeastward as it moved around the circulation of the LOW that stalled over Unimak Island. By 1200 of that day, it had been absorbed by the older system.

Casualties--There are no weather-related casualties known at this time.

Marine Weather Diary

NORTH ATLANTIC, AUGUST

WEATHER. The favorable weather that is characteristic of summer continues into August, the warmest month of the year over the North Atlantic. The monthly pressure analysis shows the 1022-mb subtropical High centered near 35°N, 43°W, while the Icelandic Low, a broad, flat, east-west trough, reaches its lowest pressure (1008 mb) over Hudson Strait.

WINDS. Over the middle latitudes (40° to 60°N), winds from the southwest through the northwest occur with the greatest frequency. North of latitude 60°N, they become northerly between Greenland and Iceland, and variable south of Iceland and over the southern Norwegian Sea. The prevailing winds over the North Sea are from the westerly quarter of the compass. Between 40° and 25°N, the prevailing direction is from the north and northeast over the extreme eastern Atlantic, and from the south and southwest over the western ocean. Northwesterlies--known by many names, including mistral, etasians, and maestro--blow over the Mediterranean Sea. The northeast trades of the Atlantic lie principally between 25° and 15°N, extending to the South American coast over the Caribbean Sea. Near the approaches to the United States at these latitudes, the trades become more easterly--the Gulf of Mexico has prevailing easterly winds. Southeasterlies are dominant near the Equator, between South America and Africa. Windspeeds on the North Atlantic in August average slightly more than force 3, with lower speeds over the western Mediterranean, the Davis Strait, and the Gulf of Mexico.

GALES. Winds of gale force, except in tropical cyclones, are very infrequent south of 52°N. North of this latitude, gale frequencies of about 5 percent are fairly common, with maximum frequencies of 10 percent or more over the Norwegian Sea and the waters south and west of southern Greenland.

EXTRATROPICAL CYCLONES. A few moderately strong summer LOWs move about north of 40°N. Storms that attain severe intensities during August are usually of tropical origin. Primary storm tracks for extratropical cyclones are from Hudson Bay to Davis Strait, and from east of the James Bay region and the eastern Grand Banks to just south of Iceland and then eastward through southern Scandinavia. A short primary track lies off the U. S. East Coast. A secondary storm track crosses eastern Lake Superior before joining the primary track over central Quebec.

TROPICAL CYCLONES. August is one of the principal months in the North Atlantic hurricane season, ranking second behind September in tropical storm development and also in the number of these storms that attain hurricane force. An average of 2.4 tropical storms occur during August, and 1.5 or 2 out of 3 develop to hurricane intensity. A maximum of seven cyclones occurred in August 1933; and, in contrast, no storms were reported during 1941 and 1961. In general, the level of tropical cyclone activity increases as August advances, with the likelihood of storm occurrence being more than twice as great in the last 10 days as during the first 10 days of the month. The spawning area of tropical cyclones is much larger in August than during the preceding month. Some tropical cyclones originate as disturbances over southwestern portions of the "African Bulge," intensify into tropical depressions southwest of the Cape Verde Islands, gather strength as they are carried across the lower latitudes of the North Atlantic by the prevailing easterlies, and then enter the Caribbean, Gulf of Mexico, Florida, or the western Atlantic, as fully developed hurricanes. A characteristic of this activity is the split mean storm track around the Bahamas, with one branch passing to the north of the islands, where it recurves off Cape Hatteras, and the other over the southern portion of the island chain.

SEA HEIGHTS of 12 ft or more are encountered more than 10 percent of the time over a portion of the northern ocean south of southern Greenland and several hundred miles southwest of Iceland. Two other areas are also observed. One lies west of the British Isles, while the other is hosted by the Denmark Strait.

VISIBILITY. In general, fog is both less frequent and less extensive than earlier in the summer. Percentage frequencies of visibilities less than 2 mi occur 10 percent or more of the time north of a line from Cabot Strait southeastward to include the Grand Banks, thence northeastward to near 50°N, 35°W, northward to 65°N, 35°W, then southeastward to Scotland. The line then extends north- and eastward to the northern coast of Norway. A 20-percent oval-shaped area, about 600 mi in diameter, is centered off Newfoundland near 50°N, 50°W. Another 20-percent area is north of Iceland over the southern Greenland Sea.

NORTH PACIFIC, AUGUST

WEATHER. Mild summer weather continues over the North Pacific. Fog decreases, but both tropical and extratropical cyclones are more numerous. Temperatures reach their maximum for the year. By the middle of the month, the 1010-mb Aleutian Low has reappeared over the northern Bering Sea, near 61°N, 178°W. The subtropical High (1025 mb) is centered near 38°N, 152°W, in August.

WINDS. The northeast trade winds are the most persistent feature. They prevail south of about 35°N, and to 40°N over the eastern ocean. Over the Philippine and South China Seas, they quickly shift to the southwest monsoon. Off the Asian coast, the winds turn to southerly, and continue to shift to southwesterly over the northern latitudes. Over the western Bering Sea, they are westerly. Over the central ocean north of latitude 40°N, and over the eastern Bering Sea, the prevailing direction is southwesterly. The winds over the Gulf of Alaska are westerly, shifting to northerly along the American coast. Winds of force 3 to 4 generally account for over 50 percent of the speeds.

GALES, although unusual in areas not affected by tropical cyclones, do occur more than 5 percent of the time over the heart of the Bering Sea, along the easternmost capes of Kamchatka, and northwest of the Bering Strait. Owing to the influence of tropical cyclones, another small area of greater-than-5-percent frequency is centered near 25°N, 134°E.

EXTRATROPICAL CYCLONES. The number of extratropical cyclones is slightly higher in August than in the preceding month. Most of these storms form off the coast of Japan and move northeastward into the Bering Sea. Others enter the Bering Sea after developing off the southeastern tip of Kamchatka; these storms often journey as far north as Kotzebue Sound. Still another primary cyclone track scampers toward the Gulf of Alaska from a point near 51°N, 158°W.

TROPICAL CYCLONES. The frequency of tropical cyclones in the western North Pacific reaches a peak in August and September. About five tropical storms can be expected in August; three or four reach typhoon intensity. Typhoons in August are displaced farther to the north than in July and have less of a tendency to pass directly over the northern Philippines. Some move directly toward Japan and Taiwan; others may pass over Japan after recurving over the Yellow Sea. Those storms that do enter the South China Sea usually move west-northwestward into the Gulf of Tonkin and North Vietnam.

Over tropical waters west of Mexico, four or five tropical storms usually occur--a maximum for any month. The average duration of these storms is 6 days, and about half attain hurricane intensity. As in July, cyclones usually move in a west-northwesterly direction out to sea, where they almost always die after meeting colder waters and more stable air. Occasionally, however, one recurves before it has moved too far from the coast and moves inland over Baja California or the Mexican mainland.

SEA HEIGHTS. During August, sea heights of 12 ft or more are rare and occur less than 10 percent of the time across the entire North Pacific Ocean.

VISIBILITY improves very slightly during August. An area about 300 mi in diameter, where the visibility is less than 2 mi over 40 percent of the time, is centered just south of the Kamchatka Peninsula. The 30-percent line surrounds this area, reaching into the Sea of Okhotsk and to the Near Islands. The 10-percent line includes the southeastern half of the Sea of Okhotsk to 40°N at 160°E, along 40°N to 170°W, to 53°N, 137°W, to the Kenai Peninsula of Alaska. This area includes all of the Bering Sea.

NORTH ATLANTIC, SEPTEMBER

WEATHER. With the approach of autumn, subdued weather conditions that characterize the summer season over the higher latitudes gradually give way to increased cyclonic activity resulting from moderate intrusions of colder air. The Icelandic Low deepens to about 1006 mb, and is centered roughly halfway between Iceland and southern Greenland. The Azores High (1021 mb), centered near 33°N, 40°W, is a little weaker than in August.

WINDS. Almost without exception, the prevailing winds are westerly between 40° and 60°N. However, over the Grand Banks and the waters east of there to about 40°W, southerly winds prevail, and winds are variable south of Nova Scotia and over the Bay of Biscay. Speeds across this latitudinal belt are generally about force 4. South of 40°N, somewhat lighter winds average about force 3. Wind directions are frequently variable between 30° and 40°N, along the axis of the subtropical High, but northerlies dominate between 20°W and the Strait of Gibraltar. Between 30° and 10°N, easterly winds predominate over the western

ocean (northeasterly over the Caribbean Sea), and northeasterly winds are the rule over eastern waters. Northwesterly winds blow over the Mediterranean, and southeasterlies are common over the extreme southern North Atlantic. Northerly winds prevail south of the Denmark Strait, while southwesterlies predominate over the Norwegian Sea. Northwesterly and southeasterly winds are most common over the southern approaches to the Davis Strait. Windspeeds north of 60°N average force 4 east of Greenland, but near the Davis Strait, more reports of force-2 winds are received than of any other speed group.

GALES. The frequency of gales increases in September, particularly over northern latitudes. Frequencies of 10 percent are found just south of Greenland's southern tip, over the open waters between northern Labrador-southern Baffin Island and southwestern Greenland, over the Norwegian Sea, and over the waters north and south of Iceland. The highest frequency, 20 percent, is found over waters well north of Iceland, and over a portion of the Norwegian Sea. Elsewhere, 5-percent frequencies are fairly common north of 50°N. South of 40°N, gales are unlikely to be encountered except in storms of tropical origin.

EXTRATROPICAL CYCLONES are more frequent than in August, and occasional severe storms may be encountered. Primary storm tracks lead northeastward from the waters off Labrador and Newfoundland to southern Iceland, and then over the Norwegian Sea. Another major storm track enters the Davis Strait from the Hudson Bay-northern Quebec region, while a third advances up the Baltic Sea from southern Scandinavia into Russia. One secondary storm track crosses the Straits of Mackinac on its way from the Great Plains to the primary track over Labrador. The storm track off the U.S. East Coast has moved seaward and extends from off Cape Hatteras to Sable Island.

TROPICAL CYCLONES. Tropical storm activity reaches a peak in September. Climatology indicates that an average of 3.3 tropical storms occur in September, 2 of which develop to hurricane strength. As many as seven tropical storms were reported in September (1949), while in 1930 there were none. The entire western ocean is subject to these storms, many of which originate east of the West Indies and move westward over or north of these islands, either to enter the Gulf of Mexico, or to recurve northeastward over western waters. Some storms entering the Gulf recurve over Florida and often parallel the U.S. East Coast. Another breeding ground for tropical cyclones is over the Caribbean, east of Nicaragua. Many tropical storms or hurricanes are still packing considerable punch when they reach northern shipping routes.

SEA HEIGHTS of 12 ft or more have a frequency of 10 percent or higher over most of the North Atlantic between 50° and 65°N, while small areas of 20-percent frequency occur off Greenland's southern tip and over the Denmark Strait.

VISIBILITY. Percentage frequencies of visibility less than 2 mi exceed 10 percent north of a line drawn from the western Labrador Sea eastward to 57°N, 48°W, and then southwestward to encompass all of Newfoundland and the Grand Banks. From there, the line extends north-northeastward to the waters south of the Denmark Strait, and then eastward, barely missing the southern tip of Iceland, before dipping southeastward to include the Pentland Firth and the Hebrides. The line then passes east of the Shetland Islands before entering the Norwegian Sea midway between Iceland and Norway. Percentage frequencies of visibility less than 2 mi decrease to less than 10 percent over the central and northern portions of the Davis Strait, but increase to more than 20 percent over the northern reaches of the Labrador Sea above 60°N, and over the waters north of Iceland, east of the Denmark Strait. Over a small portion of the latter area, near 69°N, 16°W, the percentage frequency of visibility less than 2 mi exceeds 30 percent.

NORTH PACIFIC, SEPTEMBER

WEATHER over the North Pacific continues to be generally pleasant in early September, but, as the month advances, early winter-type storms occur over the northern shipping lanes. Western portions of these routes are also subject to tropical cyclones. A closed Aleutian Low reappears in September, centered over southwest Alaska, with a central pressure of 1007 mb. The 1021-mb subtropical High, near 36°N, 146°W, has weakened considerably and is centered about 300 mi southeast of its August location.

WINDS. The prevailing winds over the middle latitudes of 40° to 60°N are from the western quadrant, shifting to more southerly near the Asian coast, and northerly near the American coast. Over the Bering Sea, they are northwesterly, shifting to northerly over the Bering Strait. The northeast trade winds are predominant south of 30°N, shifting to the north along the American coast, and southwesterly winds predominate over the southern Philippine Sea and South China Sea, where the southwest monsoon is firmly established. There are two areas where the winds appear to be out of phase. One is the northern Gulf of Alaska, with prevailing easterlies; and the other is along the coast of southern China and the East China Sea, with northeasterlies. The average speed is force 3 to 4.

GALES. Winds of 34 kt or higher are encountered between 5 and 10 percent of the time over much of the open Pacific north of about 45° to 50°N over eastern waters, and between about 37° and 45°N over western waters. A typhoon-influenced area of frequencies greater than 5 percent extends from the East China Sea to the Philippine Sea.

EXTRATROPICAL CYCLONES. Well-developed extratropical storms occur more frequently in September than in August. Most of these move northeastward from the Japanese Islands to pass over southwestern Alaska. Others enter the Gulf of Alaska from the wa-

ters south of the eastern Aleutians. Storm tracks are displaced southeastward from those of August.

TROPICAL CYCLONES. On the average, four or five tropical storms can be expected in the western North Pacific in September, almost as many as in August. About three of these will achieve typhoon strength. These storms usually originate in the lower latitudes west of about 150°E, and initially move west-northwestward. Some travel across the northern Philippines and the South China Sea, while others recurve in the vicinity of the Philippine Sea to pass over or near the Japanese Islands.

About three tropical storms will whirl off the Mexican coast in any given September. One or sometimes two will usually become a hurricane. These storms either originate over the waters off southern Mexico and move northwestward parallel to the coast (and sometimes inland), or develop near the Revillagigedo Islands and move westward out over the open ocean.

SEA HEIGHTS of 12 ft or more are common 2 to 10 percent of the time north of about 35°N over eastern waters, and north of about 30°N over western waters (excluding the Bering Sea)--as well as over the South and East China Seas, the Gulf of Tehuantepec, and the lower Gulf of California. Two areas of maximum frequency greater than 10 percent are within an elliptically shaped area between 46° and 50°N, and 162° and 179°E, and over the Okhotsk Basin.

VISIBILITY. Fog is less prevalent in September than in August, but it is still frequent north of about 40°N. Frequencies of 10 percent or more of visibility less than 2 mi are common over the waters between 40°N and the Bering Strait, west of 145°W, and east of 150°E. However, the Alaska Peninsula and the Gulf of Alaska, included within the above area, host frequencies of less than 10 percent. A region of frequencies greater than 20 percent surrounds the waters of southern Kamchatka southwestward to the central Kurils, then eastward to Ostrov Beringa.

THE MARINERS WEATHER LOG WELCOMES ARTICLES AND LETTERS FROM MARINERS RELATING TO METEOROLOGY AND OCEANOGRAPHY, INCLUDING THEIR EFFECTS ON SHIP OPERATIONS.

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